RÉSUMÉ

1. Cadre du travail et sources de renseignements

Le CANMET a défini le cadre du présent rapport. La préparation du rapport a été assignée à Norwest Resource Consultants de Calgary, en Alberta en collaboration avec ses sous-conseillers, Jacques Whitford and Associates de Halifax, en Nouvelle-Écosse et G.G. McPhail de Sault St. Marie, en Ontario.

Les renseignements fournis dans ce rapport ont été obtenus en:

a) Visitant les ministères de chaque province qui administrent la législation portant sur le sauvetage dans les mines.

b) Communiquant avec les inspecteurs en chef du Yukon et des Territoires du Nord-Ouest.

c) Communiquant avec la Station de sauvetage dans les mines, à Essen en République fédérale allemande.

d) Visitant le National Coal Bureau Mine Rescue Service en Grande-Bretagne et une station de sauvetage dans les mines du N.C.B.

e) Visitant les installations de sauvetage de la M.S.H.A. à Pittsburgh, aux États-Unis, et en allant à la West Virginia Mining Extension.

f) En visitant certaines mines au Canada:
   (i) Syncrude: mine à ciel ouvert de sable bitumineux
   (ii) B.C. Coal: mines souterraine et à ciel ouvert
   (iii) Cominico Sullivan mine: mines souterraine et de roche dure

g) Appelant ou en visitant des représentants de fabricants et des fournisseurs d'équipement de sauvetage au Canada, de même qu'aux États-Unis.

h) Discutant avec de nombreuses personnes bien informées au sujet du sauvetage dans les mines, au Canada, aux États-Unis et en Grande-Bretagne.

i) Puisant de l'information de diverses publications, notamment du compte rendu du "Crisis Management Symposium", tenu à Sydney, en Nouvelle-Écosse, en 1982.

L'annexe I donne la liste des remerciements, et l'annexe II contient la bibliographie.

2. Vue d'ensemble de l'industrie minière au Canada

On note l'importance de l'exploitation minière dans l'économie canadienne, de même que les différents genres d'exploitation minière. On passe en revue, de façon générale et par province, l'urgence des opérations de sauvetage dans les mines et l'évolution de leurs rôles traditionnels. On met en relief certaines conclusions:

a) Dans le passé, les mises au point et les améliorations n'ont été apportées qu'après des incidents importants impliquant un nombre élevé de pertes de vie humaine et matérielles.
b) Les participants aux opérations de sauvetage sont déterminés à la tâche et travaillent sur une base volontaire.
c) Les changements proposés doivent prendre en considération les traditions actuelles des opérations de sauvetage, l'"esprit de Corps" et l'aspect volontaire du travail.

3. Exigences législatives

On passe en revue la législation existant d'un bout à l'autre du Canada concernant le sauvetage dans les mines. On fait aussi allusion à la législation britannique et américaine. L'annexe III contient une copie des législations canadienne et étrangères pertinentes. On indique la différence entre la législation des différentes provinces, en mentionnant les moyens de mettre en place un système flexible et qui partagerait les responsabilités entre le gouvernement et l'industrie.

4. Organisation du sauvetage dans les mines

On décrit brièvement le cadre législatif et organisationnel dans lequel s'effectue les opérations de sauvetage dans les mines, pour chaque province. Lorsque jugé approprié, on établit des comparaisons avec les organismes de certaines juridictions étrangères.

On a pris note des appareils de secours disponibles dans chaque province. On décrit les principes de surveillance et d'inspection des installations de sauvetage dans les mines.

On compare les organisations canadiennes et étrangères et on tire les grandes lignes d'un sauvetage bien organisé. On discute de la direction des opérations de sauvetage et on conclut que cette responsabilité devrait incomber à la gestion des mines. Le rapport suggère que le transport d'hommes et d'équipement vers les mines éloignées pourrait être du ressort du fédéral.

5. Équipe de sauvetage - sélection des candidats

On discute des qualifications exigées des membres des équipes de sauvetage: l'âge, l'état de santé, la condition physique, la formation reçue dans le domaine des opérations de sauvetage et des premiers soins.

Lors de la discussion portant sur la composition et la sélection des équipes, on a noté l'importance de choisir de bons capitaines d'équipe et des compétences particulières. On passe en revue la rémunération des membres des équipes de sauvetage dans chaque province. Le rapport suggère l'opportunité de constituer un petit groupe chargé d'établir des directives en vue de fixer des normes interprovinciales de sélection des candidats, en ce qui a trait:

a) à l'âge minimal requis et maximal permis;
b) aux normes des examens médicaux;
c) à l'évaluation de la condition physique;
d) à l'évaluation de la stabilité émotive;
e) à l'expérience dans le domaine minier;
f) au nombre de personnes devant constituer une équipe.
g) aux certificats exigés.

6. Formation pour les cas d'urgence et les opérations de sauvetage

On discute de la valeur de la formation des nouveaux travailleurs pour les cas d'urgence, en faisant référence aux exigences législatives et en mettant l'accent sur la formation de pompiers. On discute aussi de la formation des surveillants afin qu'ils dirigent efficacement les opérations de secours au travail et on met l'accent sur la responsabilité qui leur incombe d'établir des plans d'évacuation et de survie. Dans le rapport, on recommande d'utiliser les "Supervisor's Emergency Action Courses", qui traite spécifiquement de l'évacuation et de la survie des groupes de travailleurs. En discutant de la formation du personnel de secours, on présente les différences entre les méthodes de formation canadienne, américaine et européenne. On accorde une attention particulière à la condition physique des travailleurs et à l'utilisation de chambres de pratique "chaudes et humides" en Europe, en indiquant les différences rencontrées en Europe, aux États-Unis et au Canada.

On discute de l'absence d'un manuel de formation canadien établissant des normes nationales. On passe en revue les méthodes de formation et l'équipement utilisés par chaque province. On signale l'infériorité du Canada dans le domaine de la formation des instructeurs en comparaison des progrès accomplis aux États-Unis. On examine la source de motiviation que constituent les compétitions de sauvetage, de même que la difficulté à obtenir la participation totale de toutes les provinces aux compétitions nationales de sauvetage. Dans la conclusion de cette section, on recommande:

a) La formation pour les cas d'urgence des nouveaux travailleurs et des surveillants, en mettant l'accent sur la lutte contre les incendies, les plans d'évacuation et de survie, et les cours de perfectionnement au travail.

b) La mise au point de directives pour la survie des groupes de mineurs coincés dans les mines, établies d'après l'expérience, suivant les conseils médicaux et de toute étude effectuée par l'armée.

c) L'évaluation de l'usage de chambres d'acclimitisation au Canada.

d) L'utilisation de manuels de formation par modules. Chaque module porterait sur un certain aspect du sauvetage et de la survie.

7. Equipement de respiration

On définit les diverses sortes d'appareils protecteurs pour la respiration, en soulignant l'importance de l'appareil respiratoire autonome pendant 4 heures. On décrit les appareils d'auto-sauvetage avec filtres et ceux fournissant de l'oxygène, ainsi que leur développement, leurs usages et les problèmes qu'ils présentent. La section 7.2 de l'annexe VII illustre certains de ces appareils.

On discute également de l'entretien de l'équipement et des appareils, et on fournit des exemples de dossiers sur l'entretien et de lignes directrices à ce sujet. Les avantages et désavantages d'utiliser l'aide de techniciens chargés des appareils sont présentés; le rapport indique qu'au Canada on ne favorise généralement pas cette mesure.

Le rapport décrit les récentes améliorations apportées aux appareils, mais il n'y avait pas d'information disponible relativement aux nouveaux modèles de prototype. On a découvert que le N.C.B. est en train de développer un nouvel appareil respiratoire, dont le prototype sera mis à l'essai sous peu. Les améliorations apportées au B.G. 174, au Oxy SR-45 et aux appareils d'auto-sauvetage avec filtres portent surtout sur de nouveaux matériaux de caoutchouc paur masques et boyaux.

On discute les avantages et désavantages de normaliser nationalement certains types d'appareils, et on en vient à conclure que la normalisation est peu désirable car elle pourrait obliger l'industrie ou le gouvernement ou les deux à se livrer à des activités de recherche et développement. On met en question le besoin de recourir à l'Approbation canadienne pour les appareils de respiration, et on met l'accent sur les problèmes reliés à l'utilisation de métaux faits d'alliages légers pour certaines parties des appareils. Le rapport suggère que le CANMET consulte les gouvernements provinciaux, l'industrie et les manufacturiers pour déterminer la valeur des Approbations canadiennes.

L'équipement utilisé pour les sauvetages d'urgence est brièvement décrit. Les articles notés comprennent:

a) L'approvisionnement en nourriture et en breuvages à travers les trous de forage à la surface, pour les mineurs coincés dans les mines.

b) Le sauvetage des mineurs coincés dans les mines à travers les trous de forage à grand diamètre.

c) Les treuils et les puits d'urgence.

d) Les postes de refuge souterrains.

e) Les aides d'équipement pour les équipes souterraines, comme les systèmes de communication, l'emploi de lumières à haute inténsité, d'instruments se tenant dans la main récemment développés, et d'analyseurs des gaz.

Le rapport décrit le genre d'équipement de communication disponible en Allemagne et en Australie. On note l'usage de lumières à haute intensité dans la fumée, et on propose l'utilisation de lumières chimiques comme repères de route. On reconnaît que les détecteurs de CO à lecture numérique présentent certains avantages comparativement aux méthodes traditionnelles des tubes de verre, surtout lorsque l'on cherche les foyers de chauffage spontané ou lorsque l'on veut étudier l'atmosphère à une base d'air frais. On considère l'emploi de thermomètres d'avertissement audio-numériques comme mesure préventive pour le travail se déroulant dans des atmosphères chaudes et humides.

L'utilisation d'équipement pour l'analyse des gaz, et de la méthode de faisceaux lumineux de tubes pour surveiller l'atmosphère dans les mines, surtout lors de la construction ou de la mise en brèche d'installations pour contenir l'incendie, est remarquée. On souligne qu'au Canada, seuls le Québec et l'Ontario permettent les équipes de trois hommes alors qu'en Australie on utilise des équipes de trois hommes spécialement formées, pour installer les faisceaux lumineux de tubes. On compare l'utilisation de lampes à l'épreuve des flammes à l'usage d'instruments, en se rapportant aux limites que présentent ces lampes et aux doutes que suscitent les instrument, quant à leur fiabilité. Le rapport conclut due l'on utilisera de plus en plus les instruments plutôt que les lampes.

On passe brièvement en revue le port de vêtements protecteurs, en soulignant que cette mesure n'a reçu que très peu de considération au Canada.

On cite en exemple des exigences typiques minimales pour l'équipement de sauvetage utilisé dans les mines à ciel ouvert. Certaines conditions spéciales canadiennes sont examinées, et le rapport inclut des commentaires sur les sujets suivants:

a) L'utilisation du transport aérien pour atteindre les mines éloignées, et les difficultés que présente le transport aérien des bombonnes d'oxygène.

b) Les conditions d'hiver, leurs effets sur le transport au sol, et l'obligation de la plupart des mines canadiennes d'utiliser des système de chauffage alimentées à l'air de l'extérieur.

c) Les problèmes reliés aux tailles élaborées, aux montages et aux pentes à pic. On insiste sur les méthodes de transport.

Le rapport suggère de se livrer à des essais permettant de tracer des diagrammes indiquant la rapidité des équipes de sauvetage pour différentes pentes et diverses distances. Ces diagrammes faciliteraient la planification des travaux de récupération. On suggère que le transport au moyen de cables et harnais est probablement le plus fiable pour les opérations de sauvetage, mais on note l'importance de prendre en considération des exigences en cas d'urgence lors de la planification de la mine.

8. Mesures d'urgence

La gestion accepte la responsabilité de préparer un "Plan de mesures d'urgences", alors qu'il incombe normalement à l'Inspectorat des mines de vérifier s'il est satisfaisant. L'emploi du système "d'avertissement d'odeur infecte" dans les mines de roche dure est décrit et on suggère que ce système soit mis à l'essai dans les mines de charbon.

On discute de certains détails des opérations de récupération, particulièrement à savoir si la direction de ces opérations revient à la gestion ou au gouvernement. Le rapport conclut que la direction des opérations de sauvetage et de récupération est très certainement la responsabilité de la gestion. Il fait également mention de l'importance de conserver des dossiers exacts et détaillés sur les activités de sauvetage, ainsi que du rôle de soutien important des Inspecteurs miniers et des fonctionnaires préposés au sauvetage dans les mines au cours des opérations de recherche.

9. Recherche et développement

On note la faiblesse du Canada en matière de recherche et de développement en ce qui a trait au sauvetage dans les mines, de même qu'en ce qui regarde la formulation de suggestions précises pour la recherche de la part du personnel canadien de sauvetage dans les mines. Ce rapport contient la liste de quelques études, essais et évaluations d'équipement effectués à l'extérieur du Canada, principalement en Europe et aux États-Unis.

On a fait un certain nombre de suggestions pour la recherche et le développement au Canada. Elles comprennent:

a) La conception de matériel didactique pour les instructeurs de sauvetage dans les mines et en particulier des maquettes.
b) Une enquête portant sur l'utilisation de voitures hermétiques, sous pression, conduites par les hommes et approvionnées en oxygène. De cette façon, les membres de l'équipe de secours pourront voyager dans ces voitures sans entamer leurs propres réserves d'oxygène.
c) Une évaluation des gaz inertes comme outil de lutte contre les incendies, en particulier dans les mines de charbon du Cap-Breton.
d) La mise en place d'une équipe de sondage à l'essai formée de mineurs souterrains afin d'acquérir l'expérience nécessaire et d'organiser les sauvetages.
e) La mise au point et l'évaluation des faisceaux tubulaires qui comprennent des conducteurs pour la communication.

D'après l'étude, il est nécessaire de considérer les améliorations à apporter aux systèmes de communication pour les sauvetages dans les mines comme des priorités des plus importantes. Ceci constitue l'opinion unanime de tous les gens qui travaillent dans le secteur du sauvetage dans les mines.

10. Proposition relative à un Centre national de sauvetage dans les mines

Le rapport conclut qu'il manque au Canada un centre où les soucis des différentes mines dans différentes régions pourraient être tous rassemblés, et d'où l'on pourrait instaurer et prendre des mesures appropriées. On suggère de demander à toutes les provinces leur appui pour l'établissement, au CANMET, d'un Centre national de sauvetage dans les mines. Ce Centre jouirait des fonctions suivantes:

a) Recueillir et distribuer de l'information technique sur le sauvetage.

b) Contrôler les activités de R & D à l'échelle mondiale.

c) Mettre à l'essai et approuver des appareils pour le Canada, s'il y a lieu.

d) Entreposer et mettre à la disposition des mines de l'équipement spécialisé comme les analyseurs de gaz.

e) Développer des aides didactiques, organiser la formation, les séminaires et la conférence annuelle nationale sur le sauvetage.

ERRATA

SURVEY & ASSESSMENT OF MINE RESCUE PROGRAMS

FINAL REPORT APRIL 1983

PREPARED BY: NORWEST RESOURCE CONSULTANTS LTD.
JACQUES, WHITFORD AND ASSOCIATES

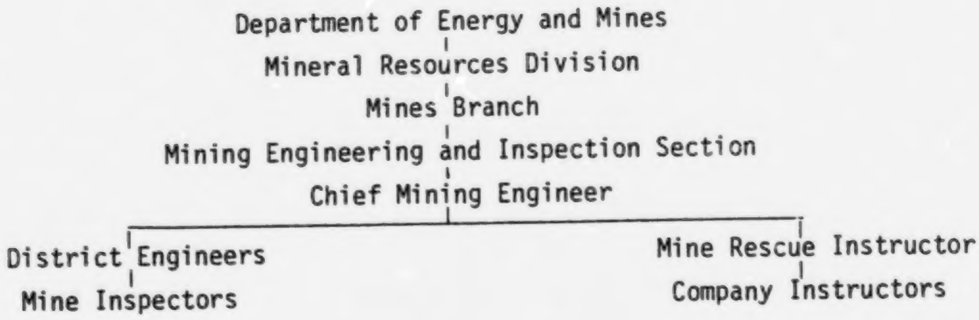
page 2-9, Manitoba

HBM&S began their mine rescue program in 1930.

page 3-7, 3.4.3 British Columbia

In mid-1983 (subsequent to the preparation of the final report) a new Mines Act and attendant regulations were promulgated. The new act consolidates the Coal Mines Regulation Act and the Mining Regulation Act into one.

page 4-19, Manitoba


Department of Energy and Mines
Mineral Resources Division
Mines Branch
Mining Engineering and Inspection Section
Chief Mining Engineer
District Engineers
Mine Inspectors
Mine Rescue Instructor
Company Instructors

. . ./2

page 4-20, Manitoba

Draeger BG-174: 115 units, 112 spare bottles

Draeger Oxy-SR: 34, 45 min; 5, 30 min.

Demand Apparatus: 13, 30 min; 23, 60 min.

Oxygen Pumps: Three U-200; three Haskel pumps

RZ Testers: Type 25, 9; Type 35 & 40, 6

High. Exp. Foam Generators: Three

Porta Phones: Five

Type N Masks: 120 +

Gas Detection Equipment: more than adequate in all locations

Personnel active as of December 1983 -

116 men on standard teams
120 supervisors
19 teams

NOTE:

There are no Chemox apparatus in use anywhere in Manitoba Mines and have not been for over six years.

page 4-31, 4.2.9 British Columbia

see comments re page 3-7

page 4-33, paragraph 3

The stations do have vehicles to transport equipment and apparatus to the mines.

page 5-8, paragraph 5, page 5-9, Summary - page 6

All reference to three man mine rescue teams has been deleted from the new manuscript of the revised Ontario mine rescue handbook. Three man teams wearing self-contained oxygen breathing apparatus can be used to conduct gas checks following major blasting operations but that duty is not considered to be a mine rescue operation.

Ontario's position is that they would prefer to have a full five man team go into operation during extreme emergencies while the standby team is still being organized, rather than have a three man team with a three man team standby.

. . ./3

page 7-9, paragraph 2, line 1

Oxy-SR's should be deleted and replaced by oxygen self-rescuers.

page 7-26, paragraph 2, line 6

Draeger has had a stainless steel BG-174 cover on the market for 3 years.

DB Stewart

D.B. Stewart
January 6, 1984

ADDITIONAL ERRATA

SURVEY & ASSESSMENT OF MINE RESCUE PROGRAMS

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page 4-15, Québec

While the administration of the Mine Rescue Service in Québec does differ in some aspects from other Provinces, C.S.S.T. inspectors were drawn from the mining inspectors and technicians who previously worked for the Mines Inspection Branch of the Dept. of National Resources. As with other Provinces, C.S.S.T. provides technical support and advice to mine operators with on-site personnel during emergencies and maintains close formal contact with other mining organizations.

page 4-3, Newfoundland

Company appointed mine rescue co-ordinators also conduct mine rescue training sessions between visits by the Mine Rescue Training Officer.

page 5-9, Québec

The policy of the Province of Québec on three-man mine rescue teams is attached.

page 6-10, Newfoundland

The Basic Course in Mine Rescue is based upon the Ontario Mine Rescue Handbook.

page 7-28, 7.7, Underground Refuge Station

Newfoundland also uses underground refuge chambers.

DB Stewart

D. B. Stewart
March 9, 1984

QUEBEC MINE RESCUE DIVISION

FIVE-MAN vs THREE-MAN RESCUE TEAMS

(Quebec - 1969)

A mine rescue team should normally be comprised of five (5) men; also individual members should not separate themselves from the rest of the team and, upon any one member becoming unable to perform his work, the whole team must then return with him to the fresh-air base.

Many reasons might be quoted for requiring this specific number of men, but we will confine our remarks in this respect by simply mentioning that a crew of this size provides the minimun of risks for its individual members under all conditions in which they may be required to work.

However

For mine rescue operations necessitating the use of self-contained breathing apparatus, we do, in certain circumstances, permit a team to have less than five (5) men, but never less than three (3). Before doing this, the following points must be carefully considered.

1 - Before starting rescue operations, a team should make sure that there are enough trained men and sufficient suitable apparatus immediately available to form and equip a stand-by team having at least the same number of members as their own team.

2 - They must make sure that the distance to be covered is relatively short, that the hazards involved are not too great, and that they know the area in which they will be travelling.

3 - The time required to complete the mission, the prevailing mine air conditions, and the strenuousness of the work involved must be taken into consideration.

4 - All other factors which could present too great a risk for a 3-man team should be considered.

5 - It is the responsibility of the person in charge of rescue operations to sanction the use of a team of less than five (5) men.

../

In almost all the mine rescue training manuals used throughout the world, it is recommended that a rescue team should be comprised of five (5) men. We concur with this principle when a major mine fire or disaster is involved. But it must be taken into consideration that we have no coal mines in Quebec, which thus eliminates one main factor, as a cause of major mine disasters. Furthermore, at all of our mines, safety and accident prevention is constantly being accentuated and, finally, here in Québec, we have a highly efficient mine rescue organization and possess top quality, light, strong, automatic mine rescue equipment which can be quickly put into use.

We can say that, before deciding to permit of the use of 3-man rescue teams, we have calculated all risks involved and have established a line of conduct accordingly. It does not seem reasonable that a mine having only six trained rescue men should have to wait for another crew to be brought in, before proceeding to extinguish a fire in its first stages before it has a chance to spread. If we permit a mine to use a two-man or three-man team equipped with type "N" masks, we cannot see any reason why one cannot use a 3-man team when they are equipped with oxygen breathing apparatus, which provides protection to the wearer in any kind of atmosphere.

We repeat again that a 3-man rescue team may be used providing that a stand-by team is available, and that the person in charge of rescue operations is of the opinion that the risks involved are not too great.

Marc Foy,
General Mine Rescue Supt.

SURVEY AND ASSESSMENT
OF
MINE RESCUE PROGRAMS

FINAL REPORT

NORWEST RESOURCE CONSULTANTS LTD.
JACQUES WHITFORD AND ASSOCIATES

WORK ON THIS PROJECT WAS CONDUCTED UNDER THE AUSPICES OF THE CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY, ENERGY, MINES AND RESOURCES, CANADA.

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TABLE OF CONTENTS

			Page
	SUMMARY		
1.	INTRODUCTION		1-1
	1.1	Scope of Work	1-1
	1.2	Approach to Task	1-3
	1.3	Sources of Information	1-4
2.	MINING AND RESCUE WORK IN CANADA		2-1
	2.1	Overview of Canadian Mining Industry	2-1
	2.2	Types of Mining	2-4
	2.3	Effect of Different Types of Mining on Mine Rescue	2-4
	2.4	Historical Review and Tradition	2-6
		2.4.1 Historical Review	2-7
		2.4.2 Canadian Mine Rescue Development	2-8
3.	REGULATORY REQUIREMENTS		3-1
	3.1	Introduction	3-1
	3.2	Atlantic Canada	3-1
		3.2.1 Newfoundland	3-2
		3.2.2 Nova Scotia	3-2
		3.2.3 New Brunswick	3-4
		3.2.4 Prince Edward Island	3-4
	3.3	Central Canada	3-5
		3.3.1 Ontario	3-5
		3.3.2 Quebec	3-5
		3.3.3 Manitoba	3-5
	3.4	Western Canada	3-6
		3.4.1 Saskatchewan	3-6

TABLE OF CONTENTS (Continued)

Page

3.4.2 Alberta 3-6
3.4.3 British Columbia 3-7
3.4.4 Yukon & N.W.T. 3-8
3.5 Foreign Legislation 3-8
3.5.1 British Legislation 3-8
3.5.2 U.S. Legislation 3-9
3.6 Commentary 3-9
3.7 Recommendations 3-12

4. ORGANIZATION OF MINE RESCUE 4-1
4.1 Introduction 4-1
4.2 Organization in Canada 4-1
4.2.1 Newfoundland 4-1
4.2.2 Nova Scotia 4-3
4.2.3 New Brunswick 4-8
4.2.4 Ontario 4-11
4.2.5 Quebec 4-15
4.2.6 Manitoba 4-17
4.2.7 Saskatchewan 4-20
4.2.8 Alberta 4-28
4.2.9 British Columbia 4-31
4.2.10 Yukon & N.W.T. 4-34
4.3 United Kingdom 4-36
4.3.1 Health and Safety Executive 4-37
4.3.2 Organization 4-38
4.4 Federal Republic of Germany 4-40
4.5 Poland 4-42
4.6 U.S.A. 4-43
4.7 New South Wales - Australia 4-50

TABLE OF CONTENTS (Continued)

Page

4.8 Observations and Comments 4-50
4.8.1 Federal Involvement 4-55
4.8.2 Surface Mine Rescue 4-57

5. MINE RESCUE WORKERS - CANDIDATE SELECTION 5-1
5.1 Introduction 5-1
5.2 Qualifications 5-2
5.2.1 Age and Physical Condition 5-2
5.2.2 Certificates of Qualification and Experience 5-5
5.2.3 Supply of Candidates 5-5
5.3 Composition and Selection of Rescue Teams 5-7
5.4 Remuneration 5-10
5.5 Comments and Observations 5-15

6. EMERGENCY AND RESCUE TRAINING 6-1
6.1 Emergency Training for New Workers 6-1
6.1.1 Outside Canada 6-1
6.1.2 In Canadian Mines 6-2
6.2 Training of Supervisors 6-4
6.3 Training of Rescue Personnel 6-6
6.3.1 In Europe (U.K. & F.D.R.) 6-7
6.3.2 In U.S.A. 6-8
6.3.3 In Canada 6-9
6.4 Training Rescue Instructors 6-14
6.5 Role of Mine Rescue Competitions 6-17
6.5.1 The Value of the Competitions 6-17
6.5.2 The Mode of the Competitions 6-17
6.5.3 Comments on Competitions 6-18
6.6 Observations and Recommendations 6-20

TABLE OF CONTENTS (Continued)

Page

6.6.1 Worker and Supervisor Training 6-20
6.6.2 Mine Rescue Team Training 6-21
6.6.3 Training Mine Rescue Instructors 6-24
6.6.4 Mine Rescue Competitions 6-24

7. MINE RESCUE EQUIPMENT 7-1
7.1 Principal Suppliers and Distributors 7-1
7.2 Respiratory Equipment 7-2
7.2.1 Introduction 7-2
7.2.2 Closed Circuit, S.C.B.A. 7-5
7.2.3 Self Rescuers 7-6
7.2.4 Air Packs 7-9
7.3 Maintenance of Apparatus and Equipment 7-12
7.3.1 Records 7-12
7.3.2 Organization 7-12
7.3.3 Apparatus Technicians 7-13
7.4 Apparatus Developments 7-14
7.5 Standardization of Equipment 7-24
7.5.1 Advantages and Disadvantages 7-24
7.5.2 Approval of Apparatus 7-26
7.6 Equipment Used For Underground Emergencies 7-27
7.7 Underground Refuge Stations 7-28
7.8 Equipment Aids for Underground Teams 7-29
7.8.1 Communication 7-29
7.8.2 Lights 7-29
7.8.3 Hand Held Instruments 7-30
7.8.4 Mine Atmosphere Analysis 7-30

TABLE OF CONTENTS (Continued)

Page

7.8.5 The Flame Safety Lamp 7-32
7.8.6 Special Clothing 7-33
7.9 Equipment Used by Surface Mine Rescue 7-33
7.10 Special Canadian Conditions 7-35

8. EMERGENCY PROCEDURES 8-1
8.1 Pre-preparation of Emergency Procedures 8-1
8.2 Warning Devices 8-1
8.3 Direction of Recovery Operations 8-2
8.4 Rescue Operations, Record of Events 8-4

9. RESEARCH AND DEVELOPMENT 9-1
9.1 Introduction 9-1
9.2 Areas of Research and Development 9-2
9.2.1 Training 9-2
9.2.2 Breathing Apparatus 9-2
9.2.3 Instrumentation 9-3
9.2.4 Transportation 9-3
9.2.5 Protective Clothing 9-4
9.2.6 Fire Fightinig 9-5
9.2.7 Location and Retrieval of Miners 9-6
9.2.8 Communications 9-7

10. PROPOSAL FOR A NATIONAL MINE RESCUE CENTRE 10-1

ACKNOWLEDGEMENTS

BIBLIOGRAPHY

LIST OF FIGURES

Follows Page

Figure 3.1 The Principal Mining Areas of Canada 3-1
Figure 4.1 Organization of Mine Rescue-Newfoundland 4-1

Page

Figure 4.2 Organization of Mine Rescue-Nova Scotia 4-4
Figure 4.3 Organization of Mine Rescue-New Brunswick 4-9
Figure 4.4 Organization of Mine Rescue-Ontario 4-13
Figure 4.5 Organization of Mine Rescue-Quebec 4-16
Figure 4.6 Organization of Mine Rescue-Manitoba 4-19
Figure 4.7 Organization of Mine Rescue-Saskatchewan 4-22
Figure 4.8 Organization of Mine Rescue-Alberta 4-29
Figure 4.9 Organization of Mine Rescue-British Columbia 4-32

Follows Page

Figure 4.10 British Coalfields Administrative Areas 4-36

Page

Figure 4.11 Organization of Mine Rescue-United States 4-47

Follows Page

Figure 7.1 Ventilation of Main Conveyor 7-37

LIST OF TABLES

		Page
Table 2.1	Canadian Mineral Production	2-3
Table 2.2	Summary of Types of Underground Mine Emergencies	2-5
Table 4.2	Nova Scotia-Mine Rescue Personnel and Equipment	4-7
Table 4.2.5	Mine Rescue Equipment-Quebec	4-18
Table 7.1	Comparison of Self Rescuers	7-8

LIST OF APPENDICES (In Separate Volume)

III MINE RESCUE AND RELATED LEGISLATION
- 3.2.1 Nova Scotia
- 3.2.2 Newfoundland
- 3.2.3 New Brunswick
- 3.3.1 Ontario
- 3.3.2 Quebec
- 3.3.3 Manitoba
- 3.4.1 Saskatchewan
- 3.4.2 Alberta
- 3.4.3 British Columbia
- 3.4.4 Yukon & N.W.T.
- 3.5.1 United Kingdom
- 3.5.2 U.S. Federal

IV MINE RESCUE OUTSIDE CANADA
- 4.3 Great Britain
- 4.4 Republic of Germany
- 4.5 Poland
- 4.6 Kentucky and Other States - Mine Rescue Service
- 4.7 New South Wales

V RESCUE WORKER SELECTION
- 5.1 Medical Examination Forms

VI RESCUE TEAM TRAINING
- 6.3.1 British Mine Rescue Training Syllabus
- 6.3.2 U.S. Training Modules

VII MINE RESCUE EQUIPMENT
- 7.2 Respiratory Equipment
- 7.3 Examples of Maintenance Records
- 7.7 Equipment Used for Underground Emergencies
- 7.8 Refuge Station
- 7.9 Trapped Miner Transmission-a U.S.B.M. Development

SUMMARY

1. Scope of Work and Sources of Information

The scope of work for this report was drawn up by CANMET. The work of preparing the report was awarded to Norwest Resource Consultants of Calgary, Alberta with their sub-consultants Jaques Whitford and Associates of Halifax, N.S. and Mr. G.G. McPhail of Sault St. Marie, Ontario.

Information used in the report was obtained from the following sources:

a) Visits to the Departments administering the legislation relating to mine rescue in each of the Provinces.
b) Communications with the Chief Inspectors of the Yukon and N.W. Territories.
c) Communication with the Essen, F.D.R., Mine Rescue Station.
d) In Britain, visits were made to the N.C.B. Mine Rescue Service and an N.C.B. Mine Rescue Station.
e) In the U.S., visits were made to the M.S.H.A. mine rescue facilities in Pittsburgh and to the University of W.Va. Mining Extension.
f) Selected mines in Canada were visited:
    (i) Syncrude: Oil-sand open pit
    (ii) B.C. Coal: open pit and underground
    (iii) Cominico Sullivan mine: hardrock, underground
g) Representatives of manufacturers and suppliers of Rescue Apparatus in both Canada and the U.S. were spoken to either by phone or in person.
h) Discussions were held with numerous persons knowledgeable about mine rescue in Canada, U.S. and Gt. Britain.
i) Information was drawn from a variety of published material, notably the proceedings of the "Crisis Management Symposium" held in Sydney, N.S. 1982.

Personal acknowledgements are listed in Appendix I. A bibliography is given in Appendix II.

2. Overview of Canadian Mining Industry

The importance of mining in the Canadian economy is noted together with the different types of mining. The emergency of mine rescue and the development of its traditional roles is reviewed both generally and by Province. Certain conclusions are underlined:

a) Developments and improvements in the past have usually been introduced only after incidents involving major loss of life and damage.
b) Mine Rescue Workers are dedicated and voluntary.
c) Proposals for change must carefully consider the existing mine rescue traditions of "esprit de Corps" and its voluntary nature.

3. Regulatory Requirements

The Legislation relating to mine rescue all across Canada is reviewed. The legislation of Britain and the U.S. is also referred to. Copies of the appropriate Canadian and foreign legislation is provided in Appendix III. The difference between the legislation of the different Provinces is noted, particularly with reference to the means of providing flexibility and the division of responsibilities between Government and Industry.

4. Organization of Mine Rescue

The legislative and organizational framework within which mine rescue operates within each Province is briefly described. Where appropriate, comparisons are made with the organizations of selected foreign jurisdictions.

The rescue apparatus available in each Province is noted. The monitoring and inspection of mine rescue facilities are described.

Comparisons are made between Canadian and foreign organizations and outline the features of a good rescue organization. The responsibility for directing mine rescue operations is discussed concluding that it should be the duty of mine management. The report suggests that the transportation of men and equipment to remote mines could be an area for federal involvement.

5. Rescue Workers - Candidate Selection

Qualifications for rescue work are discussed including age, medical condition, physical fitness and certification of training in rescue and first aid.

In discussing the composition and selection of teams, the importance of providing good team captains and special skills is noted. The remuneration offered to rescue workers in each Province is reviewed.

The report suggests that a small group might be given the task of drawing up guidelines for an interprovincial standard of candidate selection which addresses:

a) minimum and maximum age
b) medical examination standards
c) fitness tests
d) evaluation of emotional stability
e) mining experience
f) number persons to constitute a team
g) required certification

6. Emergency and Rescue Training

The value of emergency training for new workers is discussed with reference to legislative requirements. Particular emphasis is given to firefighting training. The training of supervisors to effectively handle emergencies in the work place is discussed with emphasis on his supervision of escape and survival procedures. The report recommends the use of "Supervisor's Emergency Action Courses" which deal specifically with escape and survival of work groups.

The training of rescue personnel discusses the differences between Canadian, U.S. and European training methods. The attention paid to physical fitness and the use of "hot and humid" practice chambers in Europe is discussed drawing attention to differences between Europe, U.S. and Canada.

The lack of a national standard Canadian training manual is dicussed. The training methods and materials employed in each Province is reviewed. The Canadian weakness in training instructors is noted in comparison to the steps being taken for Instructor training in the U.S. Attention is drawn to the motivating force of the Rescue Competitions together with the difficulties of getting all Provinces to participate fully in truly National Rescue Competition. This section of the report concludes by recommending:

a) Emergency training for new workers and supervisors with emphasis on firefighting, escape and survival and the use of on-the-job refresher courses.
b) Development of guidelines for group survival of trapped miners based on experience, medical advice and any studies conducted by the military.
c) Assessment of the application of acclimatization chambers in Canada.
d) Use of training manuals based on a modular system. Each module dealing with a different aspect of rescue and survival.

7. Respiratory Equipment

The types of breathing and respiratory protection apparatus are defined. The value of 4 hr self-contained breathing apparatus is noted. Self rescuers, both the filter type and oxygen type, are described together with their development, problems and uses. Appendix VII, Section 7.2 illustrates examples of respiratory equipment.

The maintenance of apparatus and equipment is discussed and examples given of maintenance records and procedures. The use of Apparatus Technicians is discussed, noting the advantages and disadvantages. The report states that, in Canada, the use of Apparatus Technicians is not generally favoured.

Recent improvements of apparatus are described but information regarding the development of new prototype models was not available. It was discovered that the N.C.B. are developing a new breathing apparatus and a proto type is soon to be tested. Improvements to the B.G. 174 and the Oxy SR-45 and filter self rescuers are mostly concerned with a new rubber material for face masks and hoses.

The advantages and disadvantages of standardizing nationally on certain types of apparatus are discussed with the conclusion that standardization is undesirable and may result in industry, government or both having to carry out research and development. The need for issuing Canadian Approval to breathing apparatus is questioned and attention drawn to the problems associated with the use of light alloy metals on some units of apparatus. The Report suggests that CANMET consults with Provincial Governments, Industry, and Manufacturers to examine the value of issuing Canadian Approvals.

Equipment used for rescue emergencies is briefly described. The items noted include:

a) Provision of food and drink to trapped miners through boreholes from the surface.

b) Rescue of trapped miners through large diameter boreholes.

c) Emergency hoists for shafts.

d) Underground refuge stations.

e) Equipment aids for underground teams. This refers to communication systems, the use of high intensity lights, newly developed hand held instruments and the use of gas analyzers.

The Report describes the types of communication equipment available and used in Germany and Australia. The use of high intensity lights in smoke is noted and it is proposed that chemical lights can be used as route markers. Digital readout CO detectors are recognized as having some advantages over the usual glass tube methods, especially when seeking the seat of spontaneous heatings and for monitoring the atmosphere at a fresh air base. The use of digital/audio warning thermometers are referred to as a precautionary measure when working in hot, humid atmospheres.

The use of gas analysis equipment and the tube bundle method of monitoring mine atmospheres, especially when constructing or breaching fire seals, is noted. It is pointed out that in Canada only Ontario and Quebec permit 3 man teams whereas Australia uses a specialized 3 man team trained to install tube bundles. The use of the flame safety lamp is compared to the use of instruments, referring to the limits of the lamp and the doubts concerning the reliability of instruments. The Report concludes that the use of the flame safety lamp will give way to instruments in many cases.

The use of protective clothing is briefly reviewed noting that in Canada its use has received little attention.

An example is given of typical, minimum requirements of equipment for surface mine rescue. Special Canadian conditions are examined. This includes comments on the following:

a) The use of air transport to reach remote mines and the difficulty of transporting oxygen bottles by air.

b) Winter conditions as they affect ground transport and demand that most Canadian mines use intake air heaters.

c) The problems of extensive workings, raises and steep gradients. Attention is drawn to transportation methods.

The report suggests trials be conducted enabling charts to be plotted showing the travelling speeds of rescue teams at different gradients and distances. These charts should aid in planning recovery work. It is suggested that rope hauled transportation is probably most reliable for rescue operations but the value of considering emergency requirements at the mine planning stage is noted.

8. Emergency Procedures

The preparation of an "Emergency Procedures Plan" is accepted as a management responsibility. Ensuring that the plan is satisfactory is normally the responsibility of the Mines Inspectorate. The use of "stench warning" systems in hardrock mines is described and it is suggested that the use of "stench warnings" should be tested in coal mines.

The direction of recovery operations is discussed in some detail dealing particularly with the question of whether direction should be a management or a government responsibility. The report concludes that direction of rescue and recovery operations is most certainly a management function. The Report goes on to discuss the value of keeping detailed and accurate records of rescue operations and the important supporting role of Mines Inspectors and Mine Rescue Officials during recovery operations.

9. Research and Development

Canada's lack of research and development in mine rescue is noted together with the lack of specific suggestions for research coming from Canadian mine rescue personnel. The Report lists some of the studies, trials and equipment tests being done outside Canada, mainly in Europe and the U.S.

A number of suggestions for research and development in Canada are made which include:

a) Designs for didactic aids for mine rescue instructors, particularly models.
b) An investigation into the use of sealed, pressurized, manriding cars with their own air supply from tanks. Rescue teams could travel in the cars without using their oxygen supply tanks.
c) An evaluation of the use of inert gas as a firefighting tool with particular reference to its application in the Cape Breton Coal Mines.
d) A borehole trial rescue of underground miners to develop the necessary experience and organization.
e) Development and evaluation of the use of tube bundles which incorporate communication conductors.

The survey showed that improvements to systems of mine rescue communication should be given a very high priority. This was an almost unanimous opinion of everyone connected with mine rescue in Canada.

10. Proposal for a National Mine Rescue Centre

The Report concludes that Canada lacks a focal centre where mine rescue concerns of the many different regions and mines can be brought together and concerted actions formulated. It is suggested that all Provinces be asked to support the setting up of a CANMET National Mine Rescue Centre.

SECTION 1
INTRODUCTION

1.1 SCOPE OF WORK

The scope of work for the "Survey and Assessment of Mine Rescue Programs" was drawn up by CANMET (Canadian Minerals and Energy Technology) a branch of the Federal Department of Energy Mines and Resources. The statement of the work required is given below.

Background

Mine Rescue in Canada is a Provincial responsibility. Each jurisdiction in Canada has evolved a mine rescue program to suit their own specific needs and problems. In the past decade there have been a number of attempts made to discuss differences and standardize approaches. These initiatives have not proven entirely successful in part because the persons charged with that duty have been Provincial officials who were heavily burdened by day to day operational responsibilities from which they could not be divorced. This contract will provide a compilation of facts and a comparative analysis which will help the Canadian Mining Industry and its Associated Regulatory Groups, assess domestic and selected foreign mine rescue programs and identify requirements to meet the needs of the Canadian Mining Industry in the 1980's.

Statement of Work

1. Through correspondence, telephone conversations and personal visits, summarize the mine rescue programs in place in Canada. This summary should include as a minimum:

a) regulatory requirements
b) industry and government organization
c) candidate selection
d) training (rescue teams and regular work force)
e) equipment (rescue teams and regular work force)
f) emergency procedures (rescue team and regular work force)
g) coal vs. hardrock vs. industrial mineral
h) underground vs. open pit, and
i) strengths and weaknesses of the programs.

2. Through correspondence, telephone conversations and personal visits, summarize the mine rescue programs in place in selected foreign jurisdictions. The United States (Federal plus State), the United Kingdom and the Federal Republic of Germany are possible foreign programs. The foreign review should briefly describe the mine rescue programs in place, their strengths and weaknesses, and major differences between them and Canadian practice.

3. It is not the intention of this contract to have the contractor produce a final report containing extracts from publications like the "Handbook of Training in Mine Rescue and Recovery Operation" issued by the Ontario Ministry of Labour.

4. As part of the previously mentioned review the contractor is expected to:

a) identify areas where R and D effort could enhance mine rescue programs
b) identify areas where a national focus or Federal agency involvement could be desirable, and
c) identify promising developments in equipment, emergency procedures etc.

The manager of the CANMET Cape Breton Coal Research Laboratory, Mr. Bruce Stewart was appointed to be the scientific authority appointed to watch over the technical content of the work; the commercial aspects were administered by the Federal Department of Supply and Services (D.S.S.). The contract was signed and work commenced on November 3, 1982.

1.2 APPROACH TO THE TASK

Norwest, as prime contractor, managed the project. The work was assigned to personnel of Norwest, (Calgary, Salt Lake City and Denver), and to Jacques Whitford and Associates (Halifax, Nova Scotia) and Mr. George G. McPhail of Ontario, as sub consultants. D. Bruce Stewart, the appointed scientific authority for CANMET, sent letters to each of the Provincial and Territorial Chief Inspectors of Mines (or to the official responsible for Mine Rescue in the province) explaining that the objectives of the study had already been presented to the Chief Inspectors sub-committee in both Quebec (in the spring of 1982) and in Sydney (in October 1982). Mr. Stewart went on to request complete and frank cooperation in responding to inquiries arising from this study.

The collecting of information and opinions was done mainly through personal visits and, to a lesser extent, through correspondence and telephone calls. Mr. G. McPhail, who is a retired Mine Rescue Superintendent from Ontario collected the information from Quebec, Ontario and Manitoba. Mr. J. Amirault P.Eng. of Jacques Whitford and Associates (Previously Chief Inspector of Mines, N.S.) gathered information from New Brunswick, Newfoundland/Labrador and Nova Scotia. Mr. Amirault also went to Great Britain. Norwest assigned Mr. A. Strickland P.Eng. to collect information from Saskatchewan, Alberta, British Columbia, Yukon and N.W.T. Mr. Karl Gurr of the Salt Lake office visited the Eastern United States. The collation and assessment of the collected information was undertaken jointly by Messrs. J. Amirault, Mr. H.G. Stephenson and Mr. A. Strickland. Final editing and report preparation was by H.G. Stephenson and A. Strickland of Norwest. A final draft report was submitted to CANMET for appproval and the final report completed shortly thereafter.

1.3 SOURCES OF INFORMATION

The information was collected from seven main sources:

a) Officials associated with administering Provincial and Territorial mine rescue responsibilities

b) Officials administering Federal mine rescue responsibilities

c) Persons representative of those who discharge the Canadian operator's mine rescue responsibilities and who could express the Canadian operators opinions

d) Persons representing the main suppliers and distributors of rescue equipment and apparatus in Canada, and

e) British personnel and installations associated with mine rescue, including:

    (i) a central station for mine rescue and training,
    (ii) NCB officials responsible for mine rescue services, and
    (iii) H.M. Principal Inspector of Mines for Great Britain

f) U.S. personnel and installations associated with mine rescue, including:

    (i) M.S.H.A. personnel,
    (ii) M.S.H.A. facilities in Pittsburgh,
    (iii) Mine Rescue training establishment in Morgantown, West Virginia, and
    (iv) Mine rescue experts in the mining department of the University of West Virginia

g) Numerous people in Canada who were able to provide information and advice as a result of their special expertise or experience.

A list of names of Canadian, British and U.S. sources of information is provided in Appendix I and a bibliography of references in Appendix II.

SECTION 2
MINING AND RESCUE WORK IN CANADA

2.1 OVERVIEW OF CANADIAN MINING INDUSTRY

The place of mining in the Canadian economy is of vital importance. In 1981 Canada exported approximately 12,500 million dollars worth of minerals excluding petroleum and natural gas.* The total production in 1981 is summarized on Table 2.1.

At the present time the levels of production are considerably lower than in 1981 due to the current state of the world economy. Nevertheless, the figures for 1981 are proposed as being more representative of the normal state of Canadian mining activity.

At this time there are somewhere between 170 and 180 mines operating across Canada, mainly in Quebec, Ontario and British Columbia, principally in the "Hard Rock" metal mining category. Of these mines, approximately 35%, that is between 60 and 65, are open pit operations and about 113 are underground.

It is in the underground mines where the need for special mine rescue services is most apparent. Fires and/or explosions in underground mines are at the root of most emergency situations which arise. Following such an event, the products of combustion, smoke, heat, gases, and oxygen deficiency, penetrate some of the underground sections and a total disruption of the normal functioning of the mine takes place. When this occurs there are high risks such as loss of life, loss of equipment and mineral resources. The resulting loss of jobs might be temporary but

* Canadian Mines Handbook 1982 - 83.

in the worst cases could result in jobs being lost permanently. Disasters such as this affect not only the miners and the mining company but also the whole community or township. In Canada, where there are many remote communities entirely dependent on a mine, the effects of an underground fire or other incident can be very wide-spread and it is largely due to the effectiveness of mine rescue facilities that disasters of this magnitude rarely occur. According to the Energy Mines and Resources Mineral Policy Discussion Paper (December 1981), the revenue generated by Canadian mines in 1980 was $14,000 million from production and $18,000 million from mineral processing. A total of 275,000 persons were employed in both mining and processing. The Mining Association of Canada quotes "over 130,000 directly employed in mining in 1981."* These figures are intended to provide some idea of the size of the industry; its economic and social importance to Canada; and also give some measure of the important place of mine rescue in the mining industry.

It should be noted that, although mine rescue has traditionally been associated with underground mining, the increasing application of open pit mining and the large capacity of the equipment being used, has resulted in the introduction of mine rescue techniques for open pit mines.

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* No statistical figure is available for persons employed underground in Canadian mines.

TABLE 2.1

CANADIAN MINERAL PRODUCTION 1981*

	Quantity	Value $ Millions
Metals:		
Iron ore	49.8 M tonnes	1,918
Other metals	2.2 M tonnes	7,480
Total, All Metals		9,398
Non-Metals:		
Solid fuels-coal, peat	39.7 M tonnes	1,094
Potash	6.8 M tonnes	1,050
Other Minerals		1,734
Structural Materials	0.39 M tonnes	1,842
Total Non-metals		5,720
Grand Total All Minerals		**15,118**

* Above values based on information supplied by Statistics Canada and published by THE MINING ASSOC. OF CANADA as well as information from the Canadian Mines Handbook 1982 - 83.

2.2 TYPES OF MINING

Having given some indication of the size and importance of the mining industry in terms of social and economic values, it is also important to bear in mind the wide diversity to be found in Canada's mines. These diversities have had a direct influence on mine rescue practice as it has developed in various regions across the country.

In this report, mineral products are divided into three categories:

a) metals, from hard rock mines,
b) fuels, coal and oil sands, and
c) industrial minerals such as salt, asbestos and potash

These products are being mined by both underground and open pit methods. The application of the chosen mining method is influenced by the characteristics of the mineral deposit; whether it is at depth; whether it is under flat or mountainous terrain; whether it is under bodies of water such as lakes or the sea; whether it is flat or steeply inclined. Sometimes it is a small deposit mined on a short term basis, sometimes a large deposit with long term mining plans based on which a community develops and becomes dependent. All of these conditions are found in Canada.

2.3 EFFECT OF DIFFERENT TYPES OF MINING ON MINE RESCUE

The diversity of minerals, deposits, terrain and mining method, influence mine rescue in three important ways.

Firstly, in the kind of hazards and emergency situations that can arise; secondly, in the means of gaining access to the mine workings so that life and mine property can be saved; and thirdly, in the types of hazards and difficulties with which rescue crews have to contend.

It is obvious that open pit mining hazards such as runaway or overturned vehicles and pit wall failures are very different from the hazards of underground mines which depend on the mining method and mineral being mined. Table 2.2 gives a summary of the type of underground mine emergencies which have been experienced in the past.

TABLE 2.2

SUMMARY OF TYPES OF UNDERGROUND MINE EMERGENCIES

Underground Emergencies	Hard Rock Mines	Coal Mines	Indust. Mineral Mines
Resulting from:			
Fires-of equipment and installations	x	x	x
Asphyxiation and noxious gases	x	x	x
Spontaneous heating of ore or coal	x	x	
Explosion of gases (i.e. methane)	x	x	x
Explosion of organic dust		x	
Explosions of sulphide dust	x		
Outbursts of strata	x	x	x
Extensive cave-in	x	x	x
Inrushes of water or mud	x	x	x

Gaining access to the mine emergency area without delay is of major importance. It is relatively easy so far as open-pit mines are concerned but for underground mines it can be, at times extremely difficult. There are mines where, due to their extent, a long journey through access tunnels of several miles may be required to reach the emergency site. Examples of this are the Undersea Mines of Cape Breton and the Potash Mines of Saskatchewan. Where shafts are used as a means of access, anything which renders the hoist or shaft unusable cuts off both the means of escape for those still in the mine, and the ingress of those who can render assistance. Very deep vertical shafts from the surface are used in the potash mines of Saskatchewan and also in the hardrock mines, both from the surface and between underground levels. In addition to shafts, there are long, steeply inclined, slopes or ramps employed in many types of mining, particularly in hardrock and coal mines.

The types of hazards and difficulties found in different types of mining are reflected in how different regions perceive which aspects of mine rescue should be emphasized, which types of apparatus and equipment are most suitable and what rescue methods can be employed. In hardrock mines it is often difficult to evacuate miners quickly through shafts. In mines with high wide roadways, there are difficulties in locating the injured when these large openings are filled with smoke; in coal mines there is often the danger of an explosion of methane and/or coal dust while rescue work is being carried out.

2.4 HISTORICAL REVIEW AND TRADITION

A full appreciation of mine rescue in Canada would not be complete without some reference to its development and traditions. Any changes and/or suggestions which might be contemplated should be evaluated with this background in mind.

2.4.1 Historical Review

Mine rescue in present day terms may be defined as:

> **"A practical procedure applied to mining in which men are trained to use breathing apparatus and other forms of life preserving equipment in order to save lives and protect property in the event of dangerous mine incidents."**

In its early stages, the idea of mine rescue was not so well defined, however there has always been a ready response of mine workers to spring to the aid of fellow mine workers in danger.

During the early years of this century the European coal mines increased rapidly in size, both in the numbers employed below ground and in their production capacity. Unfortunately, the demand for coal outstripped the application of scientific knowledge and ventilation technology to achieve commensurate improvements in safety. This led to explosions of methane gas and coal dust of massive proportions resulting, at times, in the total loss of the mine and horrendous loss of life. As science and technology caught up to production demands and social conditions changed, the loss of life and property became more intolerable. Gradually, industry, mine owners and government legislators, turned their attention to improving mine safety. The practice developed, of training teams of volunteer miners to use specially designed breathing apparatus which enabled them to work in the smoke and fumes that followed an explosion. It is important to understand that, even from the earliest times, mine rescue has always been used not only to rescue men but to preserve the mine property and restore the mine to normal working as soon as possible.

Mine rescue developed first in the coal mines of Great Britain and it is principally from this source that Canada's practices and legislation are derived. Eventually the effectiveness of organized mine rescue was recognized by the hardrock mines and became an accepted feature in the metal and mineral mining industry. It is only within these last few years that mine rescue has started to play a role in Canada's open pit mines.

2.4.2 Canadian Mine Rescue Development

The influx of coal miners from Europe, notably Great Britain, to the areas of early coal mining developments in Canada, led to the first application of mine rescue techniques and equipment in Canada's coal mines and from there spread to the hardrock mines.

Earliest organized coal mining in Canada was in Nova Scotia in 1720, followed by major coal mining developments in Nanaimo, on Vancouver Island, and in the Crows Nest Pass area of Alberta and B.C.

Alberta and British Columbia

Mine rescue teams equipped with breathing apparatus were introduced at mines in the Crows Nest Pass around the turn of the century. In 1905, the newly formed Province of Alberta made the Department of Public Works responsible for organizing mine rescue. It provided special equipment and training and established mine rescue stations in the coal mining areas. In 1913 Canadian Pacific Railways (C.P.R.) donated a special "mine rescue railway car" bringing rescue and first aid training into the mine sites.

Major coal developments in B.C. were centred around Nanaimo. In 1909 there was an explosion in the No. 2 West Mine Extension Colliery in which 32 men were killed. Enquiry revealed inadequate preparedness for this kind of emergency and it became obligatory in B.C. for coal mines to provide rescue training. The first Provincial Rescue Station was opened in Nanaimo in 1913 and another followed shortly after in Fernie on the B.C. side of the Crows Nest Pass. In 1914, on the Alberta side of the Crows Nest Pass, an explosion occurred at the Hillcrest Mine. The "Hillcrest Explosion", in which 189 lives were lost, remains to this day as Canada's worst mining disaster. The C.P.R. mine rescue rail car was used to support the mine rescue teams in the recovery operations.

The first mine rescue training for hardrock mining was in B.C. in 1917 at the Anyox Mine north of Prince Rupert. The Sullivan mine at Kimberly started using trained mine rescue teams around 1931. In 1947, after an explosion of methane gas at the Pacific Eastern gold mine (in the Bridge River district), British Columbia introduced legislation requiring mine rescue teams and apparatus at hardrock mines.

Ontario

In Ontario, mine rescue began as a result of a fire at Hollinger Gold Mine, Timmins, in 1928. Rescue teams were sent to Timmins from Pittsburgh Pa. by the U.S. Bureau of Mines. A Royal Commission of Enquiry into the 39 deaths at Hollinger, recommended the establishment of mine rescue stations in Ontario and that the training of teams and selection of equipment should follow the practices established by the U.S.B.M.

Manitoba

In Manitoba, the Hudson Bay Mining and Smelting Co. began training 10 men in mine rescue and purchased 10 sets of McCaa breathing apparatus. In 1948 this arrangement was upgraded to a Main Station standard. Other mines soon followed suit after a fire, in the East Malartic underground mine in Quebec (1947), resulted in 9 fatalities.

Quebec

It was the East Malartic fire which resulted in Quebec establishing mine rescue stations at Val d'Or and Noranda in 1948 and later at Thetford Mines. Thirteen substations are now equipped and maintained so that every mine in the Province either has rescue equipment on site, or the equipment can be on site within 15 minutes.

Saskatchewan

The mine rescue service in Saskatchewan had its beginning at the Eldorado uranium mining operations. During the start up stages of Eldorado's development in the early 1950's, a mine rescue instructor was brought in from Hudson Bay Mining and Smelting to train mine rescue personnel. Around 1955-56, a mine rescue station was established in Uranium City consisting of a building, mine rescue apparatus and equipment, and a van for transportation. A Mine Rescue Superintendent, Mr. Herb Aitchison, was assigned to provide training and organize mine rescue services for about fourteen small mining operations in the area around Uranium City. From its beginning to its recent closure, mine rescue services at Eldorado have been under the supervision and administration of the Province of Saskatchewan.

Nova Scotia

Organized coal mining in Nova Scotia started as early as 1720. The Dominion Coal Co. was formed in 1893. Following development of the larger coal companies, mine rescue teams became an accepted part of coal mining after about 1915. Prior to the mid 1950's, mine rescue in Nova Scotia was required by legislation but with the responsibility for this function "understood" to rest with mine management. The government did not play a major role in inspecting either rescue programs or facilities.

In 1956, following the first Springhill disaster, which involved major loss of life, a Royal Commission of Inquiry was established to investigate the cause of the explosion and ensuing fire. One of the findings of the Commission was the apparent weakness in the provision of mine rescue services in Nova Scotia.

As a result of these findings the Provincial Government undertook to establish a mine rescue facility and to hire permanent mine rescue instructors to ensure provision of adequate mine rescue services to underground mines in Nova Scotia. The essence of this function remains today;

a) to ensure an adequate supply of trained men and equipment, and
b) to provide operational advice to mine management at times of crisis.

Newfoundland

Prior to 1978 all mine rescue programs in Newfoundland were left to mine management. An ammendment to the Mines Act provided for the establishment of Mine Rescue Stations and mandatory training programs in mine rescue. This ammendment placed the onus for the organization of mine rescue upon the Provincial Government and allowed for an assessment of the costs to be levied on the operating mines.

New Brunswick

Formal mine rescue programming in New Brunswick was initiated in the 1960's with the hiring of a permanent Mine Rescue Instructor and the establishment of a mine rescue station in Bathurst. At that time, the Province had only one underground metal mine which had operated at limited production since the late 1950's. Although other underground mines have recently been developed, the Bathurst Station remains the headquarters for mine rescue programs in the Province.

Yukon and Northwest Territories

Mine rescue services in the N.W.T. were instituted around 1946 - 47 with a mine rescue station in Yellowknife supported by the mines of the area. The Resident Mine Inspector was made responsible for the Station and rescue services, assisted by a Mine Rescue Superintendent who provided mine rescue training.

In the Yukon Territories, a mine rescue program was formally established in the mid 1960's after a fire at the United Keno Hills Mines claimed several lives. A mine rescue station was built at Whitehorse in 1969. This station is still in use, staffed by a Mine Rescue Superintendent.

Conclusion

This brief historical review outlined the origins of mine rescue in Canada and underlines several important factors relating to mine rescue developments:

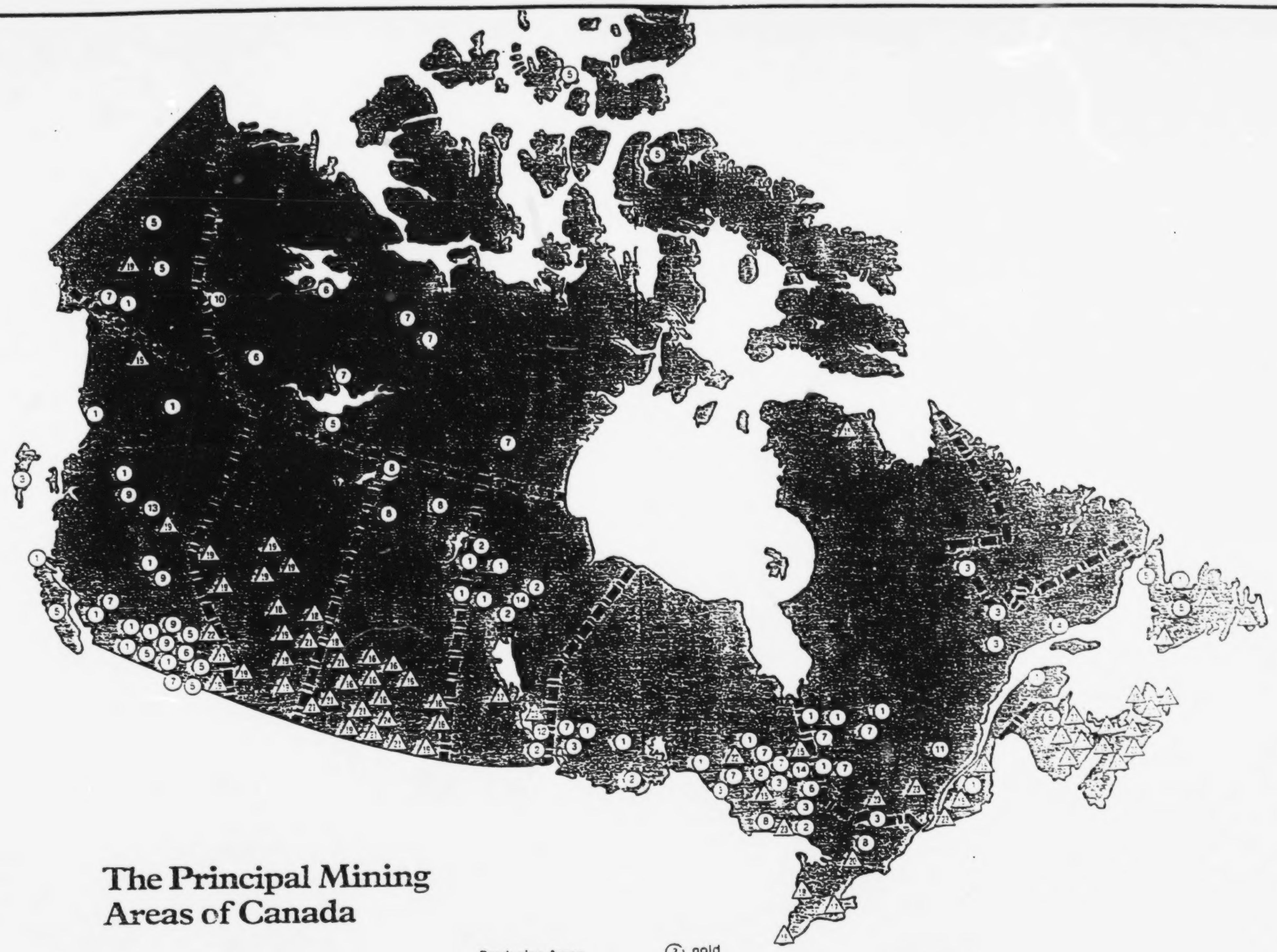
a) Mine rescue developments, in the areas of legislation, modes of operation, and apparatus and equipment, have almost always followed incidents in which there was a major loss of life and serious damage.

b) Mine rescue workers traditionally have displayed an "esprit-de-corps", self discipline and confidence, and a dedication, probably unequalled anywhere except perhaps, in wartime combat.

c) It should never be forgotton that, although there is some remuneration, the willingness to undertake mine rescue training and be ready to accept the danger, risk to life and exhausting physical hard work when an emergency arises - IS PURELY VOLUNTARY.

ANY ACTION OR CHANGES WHICH MAY UNDERMINE OR WEAKEN THESE IMPORTANT HUMAN FACTORS WOULD BE ILL-ADVISED.

FIGURE 3-1



The Principal Mining Areas of Canada

Published by THE MINING ASSOCIATION OF CANADA

Producing Areas
Metals
① copper, copper-zinc
② nickel-copper
③ iron ore
④ iron ore — titania
⑤ lead-zinc-silver (copper)
⑥ silver
⑦ gold
⑧ uranium
⑨ molybdenum
⑩ tungsten
⑪ niobium (columbium)
⑫ tantalum
⑬ mercury
⑭ cobalt
Non-metals
15 asbestos
16 potash
17 gypsum
18 salt
19 coal
20 nepheline syenite
21 sodium sulphate
22 barite
23 silica
24 bentonite

SECTION 3
REGULATORY REQUIREMENTS

3.1 INTRODUCTION

In any discussion relating to present day Canadian mining it is important to review the current situation and ensure that conventional beliefs are still valid. If the centres of Canadian mining are perceived as being concentrated in the older mining areas of Ontario and Quebec, such as Timmins, Sudbury, Kirkland Lake, Noranda-Rouyn, Malartic - Bourlamaque etc. then a glance at Figure 3.1, "The Principal Mining Areas of Canada" will show that mining activity is now widely spread across all the provinces in Canada. Provincial mine safety and mine rescue legislation have developed accordingly. A brief discussion of legislation in each province follows and appropriate sections of the legislation are provided in Appendix III.

3.2 ATLANTIC CANADA

Mine Safety statutes in Atlantic Canada respresent very diverse approaches in terms of legislation. Nova Scotia, with a long history of coal mining operations, has more definitive, less modern, statutory requirements. Newfoundland has the most recently drafted legislation which is, in effect, brief Enabling Legislation. In New Brunswick, the Department of Labour recently assumed responsibility (from the Dept. of National Resources) for the administration of legislation relating to mine rescue. At this time a Commissioner of Occupational Health and Safety is in the process of drafting formal legislation which will deal with mine rescue along with other Occupational Health and Safety matters.

3.2.1 Newfoundland (Appendix III Section 3.2.2)

Prior to 1977, mine safety programs were administered by a Ministry of Mines through the "Mines (Safety of Workmen) Regulations Act 1957." In June of 1977 that act was repealed and immediately adopted as Regulations under the newly proclaimed Occupational Health and Safety Act. Statutory authority for mine safety in Newfoundland is now administered by the Department of Labour and Manpower through the office of the Director, Mines Inspection Branch.

As a result of the above changes, the prime responsibility for the provision of mine rescue programs in Newfoundland was shifted by legislation from mine management to government.

The current legislation is not complex and deals with three major points.

a) the establishment of Mine Rescue Stations by government
b) the recovery of costs from industry, and
c) the stations to be supervised directly by government personnel.

Details of mine rescue programs are established by Codes of Practice authorized by the Chief Inspector.

3.2.2 Nova Scotia (Appendix III Section 3.2.1)

Within Nova Scotia, mine worker's safety/mine rescue legislation applies to three categories of Mines.

The Metalliferous Mines and Quarries Regulation Act administered by the Department of Mines & Energy applies to all mines except coal mines. Mine Rescue provisions for coal operations under provincial jurisdiction is provided for under the Coal Mines Regulations Act. Coal mines operated by the Cape Breton Development Corporation (C.B.D.C.) - a Crown

Corporation, are considered to be Federal undertakings. Mine Rescue and Safety are provided for and administered by Labour Canada under the Coal Mines (C.B.D.C.) Safety Regulations - Canada Labour Code.

The Metalliferous Mines and Quarries Regulation Act was originally drafted primarily to service the N.S. gold mines which existed during the first half of the century. Four regulations refer briefly to the supply and maintenance of rescue equipment, and the provision of trained personnel. Both are the responsibility of mine management.

The Coal Mines Regulation Act, which was originally patterned after British Legislation, deals with mine rescue in more detail. A local Board of Examiners is established to certify competence of mine rescue workers. Station superintendents, mine rescue captains and mine rescue team members must have certain educational and medical qualifications and must be within a specified age limit. Detailed regulations cover the provisions for the following items:

a) ambulances
b) first aid
c) breathing apparatus
d) rescue station
e) team organizations
f) instructions to teams
g) reciprocal support between mines, and
h) refuge chambers.

Of prime significance today is the provision for the establishment of rescue stations by the Provincial Government.

The Canada Labour Code - Coal Mines (C.B.D.C.) Safety Regulations, simply refer to Nova Scotia Legislation for purposes of mine rescue. By mutual agreement between parties Nova Scotia currently provides inspection services related to mine rescue on behalf of Labour Canada.

As a result of the C.B.D.C. No. 26 Colliery explosions, in February 1979, various codes of practice have been developed and adjustments have been made to the Safety Regulations particularly as they relate to personnel certification. No major changes were made to Regulations relating to mine rescue.

3.2.3 New Brunswick (Appendix III Section 3.2.3)

New Brunswick Legislation exists under the Occupational Health and Safety Act Regulations administered by the Compliance Division of the Occupational Health and Safety Commission.

Eleven Regulations provide for the following activities:

a) establishing, equipping and staffing of mine rescue stations
b) training of personnel
c) establishment equipment and trained personnel at mines
d) directing rescue operations by mine management, and
e) recovering government costs by assessing the mines.

Further details are established by means of Codes of Practice and through cooperation between the government's Mine Rescue Officer and the mine operators.

3.2.4 Prince Edward Island

No mines are operating or are under development on Prince Edward Island and therefore no mine safety legislation exists.

3.3 CENTRAL CANADA

3.3.1 Ontario (Appendix III, Section 3.3.1)

The authority for organization and financing of a mine rescue service, for the establishment of Mines Rescue Stations and for the assignment responsibilities, is given under the Occupational Health and Safety Act 1978, Section 16, Ontario Regulation 660/79.

Eight brief Regulations allow the Minister and the Ministry to exercise certain discretionary powers such as the appointment of a Mine Rescue Officer and to establish highly competent mine rescue stations.

3.3.2 Quebec (Appendix III, Section 3.3.2)

By virtue of the Quebec Mining Act, Orders-in-Council have established Regulations for the Safety and Protection of Workmen in Mines and Quarries. These Regulations authorize the Minister to establish and maintain rescue stations and recover the cost of the stations proportionately from the mines they serve. Provision is made for the appointment of Mines Inspectors to ensure that the Safety Regulations are being observed.

The Safety Regulations dealing with mine rescue, fire hazard and fire protection are not lengthy or detailed. Flexibility is maintained by vesting some discretionary power with the Chief Inspector.

3.3.3 Manitoba (Appendix III, Section 3.3.3)

Mine Rescue in Manitoba is provided for by "The Mines Act - chapter M160 and Manitoba Regulation 254/73 (M160 - R3M) made under the Mines Act.

Regulation 42 deals with the establishment of rescue stations, persons in charge of rescue stations, mine rescue crews and the supervision of crews. Regulations also provide for the appointment of Inspectors and outline their powers.

3.4 WESTERN CANADA

3.4.1 Saskatchewan (Appendix III, Section 3.4.1)

The Occupational Health and Safety Act enables Regulations and Codes of Practice to be drawn up dealing with training, work of a hazardous nature and the appointment of Occupational Health officers. It also provides for Occupational Health officers of Saskatchewan to work on behalf of another province and on behalf of the Government of Canada. This is designed to cover the operations of uranium mining by a Crown Corporation and the Operations of Hudson Bay Mining and Smelting which extends into both Saskatchewan and Manitoba.

Under Section 13 of the Occupational Health and Safety Act, there are two sets of Regulations which can be applied to mines:

a) The Occupational Health and General Regulations. These require instruction, training, and supervision of mine workers and safe ingress and egress from the mine.

b) The Mines Regulations. These provide for emergency procedures and training, and mine rescue.

3.4.2 Alberta (Appendix III, Section 3.4.2)

The Province of Alberta is in a transitionary stage, both with Mine Safety Legislation and its administration. In 1967 the responsibility for the Provincial Mine Rescue Program was assigned to the Department of Mines and Minerals, though the cost of the mine rescue program was funded through the Workmen's Compensation Board (W.C.B.) Legislation relating to coal mining safety - the only type of mining in the province at the time - was contained in the "Coal Mines Regulation Act". In 1971, the responsibility for conducting the mine rescue program and providing a mine inspection service, was transferred to the Energy Resources Conservation Board. At this time the Mine Rescue Instructors, who were mine employees, were paid by the W.C.B. for time devoted to mine rescue training and apparatus maintenance.

In 1974 new mine safety legislation was brought into force by "The Coal Mines Safety Act" and the "Coal Mines Safety Regulations" made under this Act. However, in 1978, responsibility for mine safety inspections and the administering of the "Coal Mines Safety Act" and its Regulations, passed to a newly formed Division of Occupational Health and Safety - Mines Inspection Branch. At this time the Mines Inspection Branch is in the process of once more reviewing the law relating to mine safety, inspection and mine rescue.

3.4.3 **British Columbia** (Appendix III Section 3.4.3)

British Columbia, recognizes that there are significant differences between hardrock and coal mining, by having two pieces of legislation dealing with mine safety mine inspection and mine rescue:

a) "Coal Mines Regulation Act" applying to Coal Mines, and
b) "Mining Regulation Act" applying to other mines such as metalliferous mines.

Both Acts are administered by the Ministry of Energy, Mines and Petroleum Resources.

3.4.4 Yukon and N.W.T.

In both Territories, Mining Safety and Mine Rescue is provided for under a Mining Safety Ordinance. The administering of the Safety Ordinances are the responsibility of an Inspector or Chief Inspector who has wide discretionary authority.

3.5 FOREIGN LEGISLATION

As reference will be made to the legislation of other countries, notably that of Great Britain and the U.S.A., copies of the relevant extracts relating to mine rescue and associated activities have been included in Appendix III under Section 3.5.1 - United Kingdom - British (Fire and Rescue) Regulations 1956; and under Section 3.5.2 - U.S. Federal - the U.S. Code of Federal Regulations, Parts 48 and 49. Reference is made to F.D.R. Legislation in Appendix IV, Section 4.4, Part A, Encl. 1 and Encl. 2.

3.5.1 British Legislation

One of the most important features of this legislation is the level of detail that is specified. Little latitude is given to the mine management or the Inspectorate to grant exemptions from parts of the Regulations. From an Inspectors point of view this is a positive feature. Detailed regulations normally result in less dissention regarding implementation. Either the facilities and programs meet the requirements of the Regulations or they do not. In terms of emergency provisions, the less discretionary the legislation, the easier it is to assess compliance. However, detailed Regulations demand considerable experience and technical knowledge from persons drafting the legislation in order to present Regulations that are complete and equitable, and that adequately protect the mine and the mine worker.

It should be remembered that British Regulations reflect the following facts:

a) the high degree of concentration of mines in the coalfields
b) most British mining is in coal with a legacy of disastrous coal mine explosions, and
c) some of the practices required by the legislation, though still effective, are not used in North America, i.e. the use of birds, (as an indication of the presence of carbon monoxide).

3.5.2 U.S. Legislation

In the United States the Code of Federal Regulations ("The Code") applies to all mines in all States. Some States have mine rescue in their mine safety requirements but in general, the Code is more demanding. In addition to legislating the mine rescue organization, Part II Section 11 of the code deals with the testing and permissibility of respiratory protective apparatus in considerable detail.

Part II Section 49 of the Code, which deals with the mine rescue organization, is very detailed and explicit, defining alternatives rather than allowing discretion; it deals with all types of mines on a national basis. Its implementation is still progressing but more in terms of quality than style or form. The progress made to date, in the establishment of a single Federal Code, has not been without its problems.

3.6 COMMENTARY

The legislation of the Provinces and Territories across Canada is not consistent; there are a number of ways in which the provision of mine rescue services is achieved. Different jurisdictions have adopted different approaches with the result that the departments or officials charged with administering the legislation do not always have the same role in each Province.

All the Provinces (except P.E.I.) have legislation of some kind requiring the provision of mine rescue services. The fact that this legislation is under Ministries of different names, or differently named departments, is not significant, and all the Provinces and Territories have a Mines Inspection Service usually headed by a Chief Inspector or similarly titled official. However, there are significant differences to be found:

a) in the method of providing flexibility in applying the legislation, and

b) in the division of responsibilities between the mine operator and the appropriate government departments

Flexibility is needed to take care of the many different circumstances that arise, such as when there are different kinds of mining, presenting different hazards within the same Province. Another example might be the need to cater for small or remote mines. The methods used to provide flexibility are, generally, as given below:

a) Very brief guideline legislation which puts the provision and standards of mine rescue in the hands of an individual, such as a Chief Inspector, (or it might be the Minister).

b) More specific legislation regarding key features with provision for Regulations setting out more detailed requirements; these Regulations allowing some scope for minor modifications to suit particular circumstances at the discretion of, say, a Chief Inspector or similar official.

c) The use of "Codes of Practice". It is not always clear just what status a "Code of Practice" might have, but the major difference between a Regulation and a Code of Practice seems to be that, a Regulation is drawn up by a Government body and applied to all cases of a specified type whereas a Code of Practice is drawn up by the mine operator - for his mine only - and it is subsequently approved by a Government body such as the Mines Department or Chief Inspector. It is then enforceable under the existing legislation. However, the operator is free to seek approval for a revised code if circumstances at his mine change significantly.

Division of responsibilities for mine rescue depends on the point of view taken. There are three main categories:

a) The Government assumes all responsibilities; that is, it sets up rescue stations; it provides rescue apparatus and equipment and maintains it in a state of readiness; it sets up training courses and trains personnel and teams and responds to emergency calls like a fire department.

b) The Operator assumes all responsibilities; he sets up a mine site rescue station; he provides rescue training instructors and rescue team personnel; he provides the rescue apparatus and equipment and maintains it in a state of readiness; he provides his own emergency response and directs his rescue and recovery operation.

c) Between the two extremes of "Government does all" and "Company does all", there are the majority of cases. Most commonly this means that the Operators supply teams, mine site rescue stations, apparatus and equipment, mine rescue instructors and direct their own rescue and recovery operations. Government supplies standard training manuals, training of mine site instructors; sets up standards and inspections to maintain the standards; and frequently maintains back-up apparatus and equipment for training and emergency use. This occasionally means complete rescue stations at strategic locations in the Province.

The quality of mine rescue service seems to be established as much by the technical skill and experience of the government officials directly involved, such as Chief Inspectors and Provincial Mine Rescue Coordinators, as by the form of legislation. However, if the legislation is too brief and does not establish standards, and a strong government committment through its mine safety departments is absent, then the rescue service is likely to suffer.

There seems to be considerable scope for establishing guidelines which would be helpful in leading Provincial Legislation towards a more consistent format and towards attaining uniform standards. This should not be taken to mean uniformity in legislation since this is entirely the concern of each individual Province.

There is in North America an increasing incidence of sueing various types of organizations, including government bodies, for damages claimed to have occurred as a result of negligence or incompetence. Up to now this has not arisen in connection with mine rescue but one can imagine a variety of possibilities. For example; faults or failures of mine rescue breathing apparatus which might be government owned and maintained; failure to arrive at an emergency within a reasonable time; accidents to rescue team members when dealing with an emergency under the instruction of management or a government official. During the investigation for this report, it was discovered that the State of Idaho had passed a "Good Samaritan" Bill (H.B. 311) in 1981 as part of the solution to the problem. Mine rescue is not only used to save lives but also to protect and recover mines. It is important that legislators do not see mine rescue only as part of a "Safety Program" and overlook its function as a means of protecting and/or recovering mine workings.

3.7 RECOMMENDATIONS

It is suggested that Provincial Mines Departments and legislators, when revising their existing Mine Rescue Legislation, pay particular attention to the following items:

a) Format of legislation, in particular the level of detail required, the degree of flexibility and the means of attaining flexibility, and

b) The possibility of law suits against mine rescue organizers and mine rescue personnel.

SECTION 4
ORGANIZATION OF MINE RESCUE

4.1 INTRODUCTION

This section of the report briefly describes the legislative and organizational framework within which mine rescue operates in each Province. Difficulties and unusual circumstances, encountered in the different Provinces, are noted.

For purposes of comparison, the structures of mine rescue organizations, within selected foreign jurisdictions, are referred to. The features of particular programs are noted, especially where they are illustrating practices which might be of value in Canada.

4.2 ORGANIZATION IN CANADA

4.2.1 Newfoundland

Mine safety legislation is administered by a Director of Mines Inspection. He is one of four Directors reporting to an Executive Director of the Occupational Health and Safety Division who in turn answers to an Assistant Deputy Minister within the Provincial Department of Labour and Manpower.

The mine inspection group consists of the following persons:

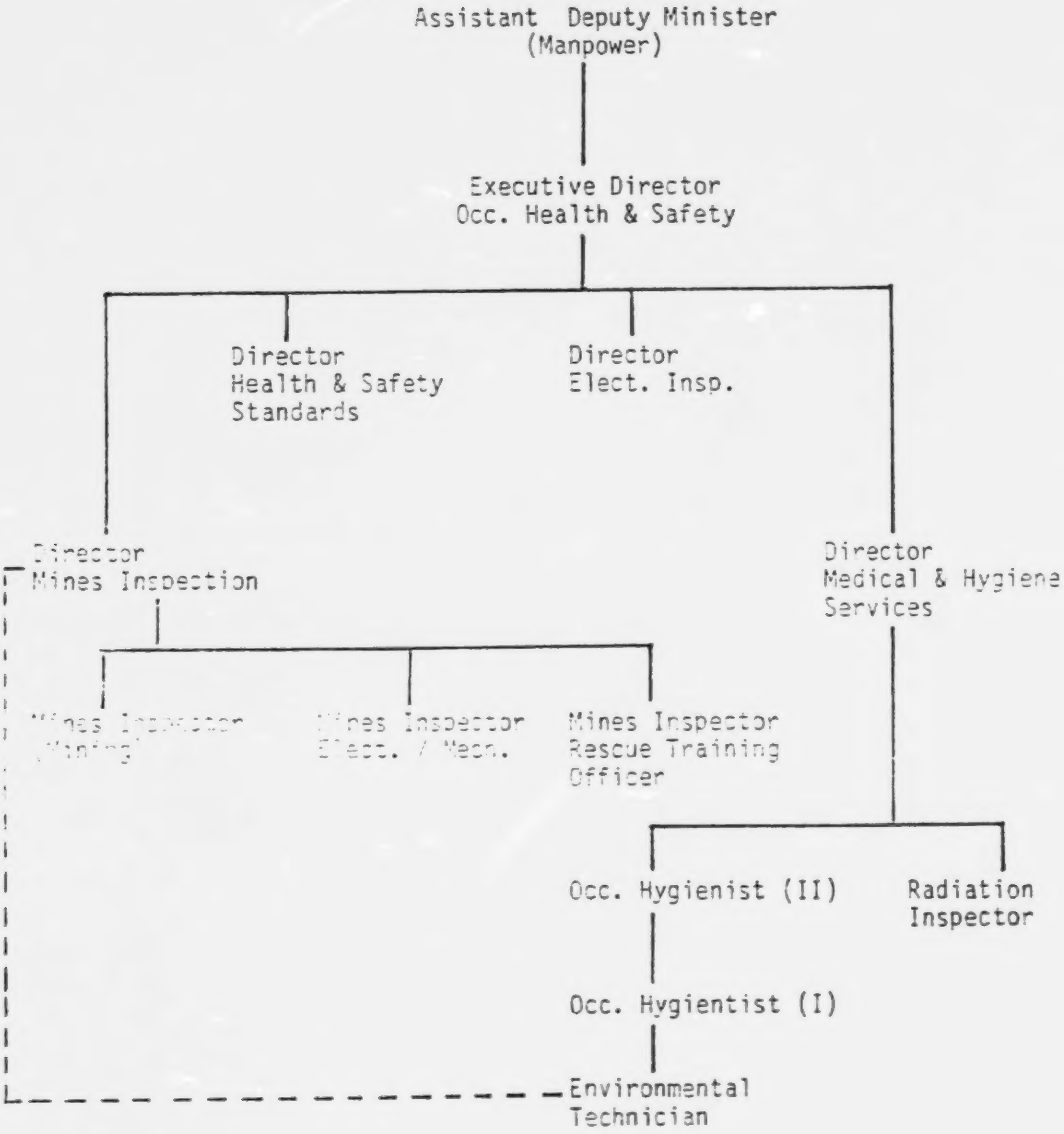
a) Mines Inspectors (Mining)
b) Mines Inspector (Elect./Mech.)
c) Mines Rescue and Training Officer
(See Figure 4.1 following)

Considering the specialized nature of their work; the support staff available from other units of the Division of Occupational Health and Safety; and

Figure 4.1

NEWFOUNDLAND

Department of Labour and Manpower
Mines Safety Organization


Assistant Deputy Minister (Manpower)
Executive Director Occ. Health & Safety
Director Health & Safety Standards
Director Elect. Insp.
Director Mines Inspection
Director Medical & Hygiene Services
Mines Inspector (Mining)
Mines Inspector Elect. / Mech.
Mines Inspector Rescue Training Officer
Occ. Hygienist (II)
Radiation Inspector
Occ. Hygientist (I)
Environmental Technician

the level of mining activity in the Province, this small group appears to be adequate for the task.

The Mine Rescue Training Officer reports directly to the Director of Mines Inspection; both operate from the same offices in St. Johns. Frequent travel to operating mines permits contact with mine site rescue personnel.

A Government operated mine rescue program was initiated in 1978 following a change in legislation which shifted the responsibility for mine rescue from the mine operators to government. This was deemed necessary as a result of the operator's failure to provide standards of mine rescue acceptable to the Director of Mines Inspection. A Mine Rescue Training Officer was appointed and a more effective mine rescue program was aggressively pursued.

Major government owned equipment items, such as breathing apparatus, are loaned to the operating mines who are responsible for maintaining the equipment in good order. The Mine Rescue headquarters in St. Johns holds a stock of spares and replacements. These are supplied to the mines on request and the user mine is charged for the parts purchased to replenish the central inventory. By operating on equipment loan with central stores and a parts supply system, the Provincial Government can ensure that adequate rescue equipment and apparatus is available at the mine site at all times. The equipment required to be maintained at each mine is given below.

Equipment	Number Required Per Mine
S.C.B.A.: BG 174	12
Self Rescuers SR30	6
Methanometers/gas detectors	2
Flame Safety Lamps	2
Oxygen Pumps	1

Station Testers	RZ25	1
	RZ 35	1
Alkaline Canisters		20

All mine rescue training sessions are currently conducted by the Mine Rescue Training Officer during regular visits to the mine sites. A supply of basic training materials is provided by the Government for distribution to mine site personnel. Because of the distances and travelling time involved, the philosophy of the mine rescue organization is centred upon well trained mine site personnel being prepared to respond swiftly and adequately in the case of emergency. Training programs pay special attention to the development of crisis management with mines being responsible for taking the appropriate emergency measures and government providing technical advice and equipment.

4.2.2 Nova Scotia

Responsibility for mine safety and mine rescue in Nova Scotia rests with the Department of Mines and Energy through the office of the Director of Engineering. This position is one of three directors (Figure 4.2) reporting to an Assistant Deputy Minister of Mines.

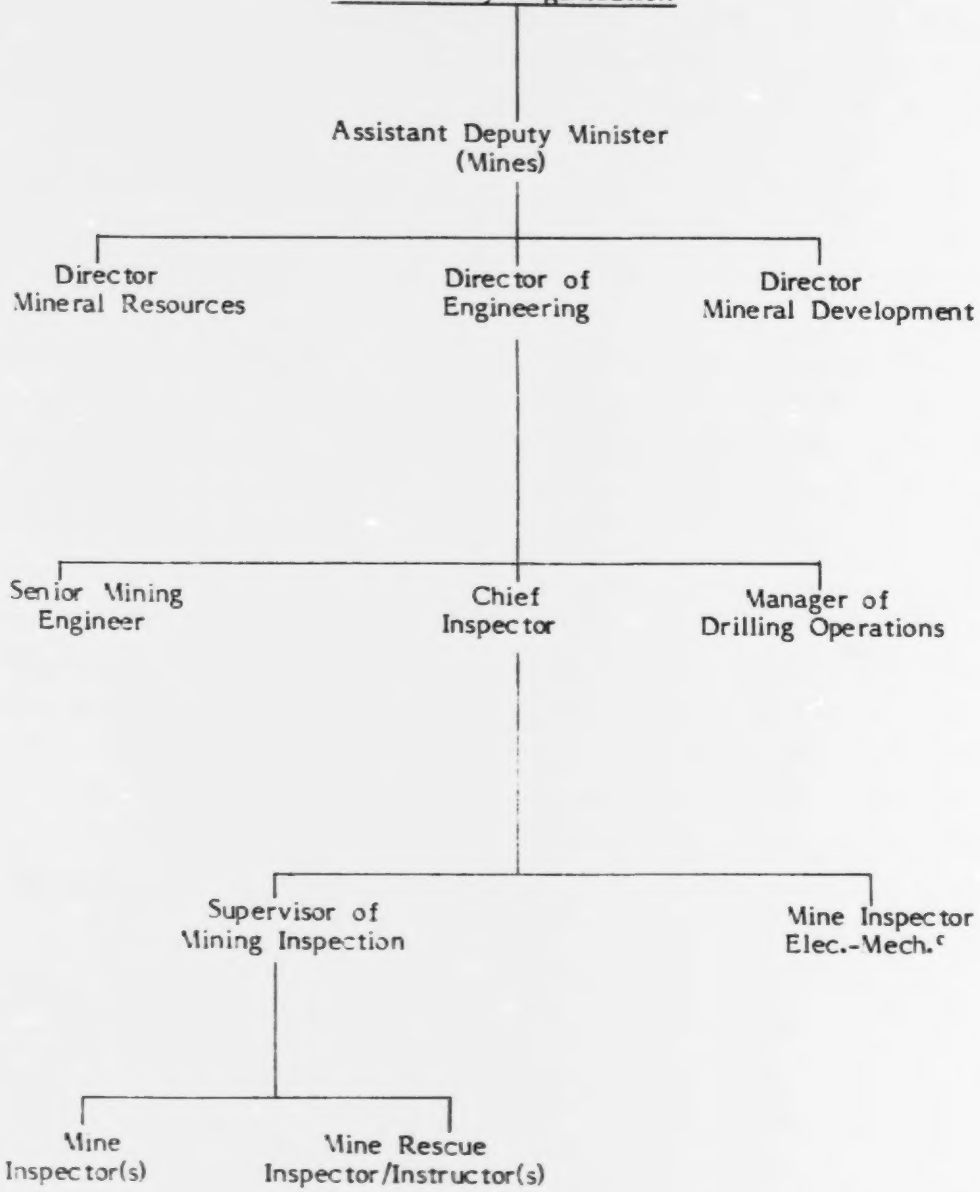
A Chief Inspector coordinates all mine inspection activities which are in two areas, electrical-mechanical and general mine inspection, the latter includes mine rescue.

The structure of the Mines and Energy Department, includes mine safety and mine rescue. The Department has undergone some changes due to departmental reorganizations and attrition within the Engineering Division.

Figure 4.2

NOVA SCOTIA

Department of Mines & Energy
Mines Safety Organization


Assistant Deputy Minister (Mines)
Director Mineral Resources
Director of Engineering
Director Mineral Development
Senior Mining Engineer
Chief Inspector
Manager of Drilling Operations
Supervisor of Mining Inspection
Mine Inspector Elec.-Mech.
Mine Inspector(s)
Mine Rescue Inspector/Instructor(s)

The Provincial Department provides mine rescue inspection services on behalf of Labour Canada for the Cape Breton Development Corporation. This arrangement between the Province and Labour Canada avoids Labour Canada appointing specialized Mine Rescue Inspectors. In addition, the Province is able to maintain a close liaison with the C.B.D.C. mines and satisfy their obligation to ensure proper resource management. This interrelationship between Labour Canada and the Province has worked successfully now for over 15 years.

The centre of Provincial Government mine rescue operations is located in Stellarton, N.S. which at one time was central to underground mining operations in the Province. A fully equipped station, complete with classroom and facilities for servicing apparatus and storing mine rescue supplies, is under the control of one of two Mine Rescue Instructors/Inspectors. A second instructor operates from Mine Inspection Offices located in Glace Bay, N.S. and primarily deals with Cape Breton operations.

Both persons provide Mine Rescue and first aid programs to mines within their area. They occasionally work together in presenting special programs. Within Nova Scotia over 3000 persons are working underground in 10 underground mining operations. The recent closure of two underground mines has reduced the demand on mine rescue services. New coal operations planned for Springhill. Stellarton and Cape Breton would soon restore the demand on the mine rescue facilities.

Good road access within Nova Scotia facilitates fast arrival at any mine site emergency which may arise. The mine rescue section has a van for transporting equipment and mines inspectors to the emergency site. The Chief Inspector has access to all department vehicles and other equipment that is normally used in support of a government exploration drill. Heavy transport trucks, dozers, winches, drills and manpower are available if needed.

The Engineering Division monitors all programs set up by mine management in Nova Scotia's mine rescue services. It is believed that mine management must take an active role in all aspects of mine rescue and that this approach will ensure adequate Mine Rescue services without undue burden on either government or management.

This approach represents a departure from earlier practice. During the 20 year period from 1950 to 1970, the mining industry in Nova Scotia was dominated by numerous small coal mining operations which, after being subsidized by government, were finally closed. While these mines were in operation, the government found it more economical to manage the entire mine rescue service. During the 1970's these small mines were replaced by larger operations which were better able to support and man the mine site rescue facilities.

Each mining operation is expected to provide at the mine, facilities, equipment and personnel sufficient to meet the immediate needs of mine rescue operations. Government conducts the training programs, and provides technical assistance and mine rescue equipment and supplies, particularly during emergencies. The disposition of Nova Scotia's mine rescue personnel and equipment is given in Table 4.2.

TABLE 4.2

NOVA SCOTIA
MINE RESCUE PERSONNEL AND EQUIPMENT

	Provincial Dept. of Mines Energy (Stellarton)	No. 26 Mine	Lingan Mine	Prince Mine	Inverness (St. Rose)	Can. Rock Salt	Beaver Const. *
Station Supervisors	2	1	1	1			
Certified Rescue Men	4	36	24	19	6	8	10
S.C.B.A. B.G. 174	18	18	12	12	6	6	6
Scott Air Packs							
Rescuers: Oxy SR 30	2	1	1	2			
Gas Detectors	2	1	1	3	1	2	
Self Rescuers	12	18	12	6		10	
Flame Safety Lamps	1	1	1	1	1	2	
Oxygen (lbs)	900	600	3,000	3 Lg.Cyl.	1,000	1,000	
Carboxide (lbs)	800	1,000	400	800	400	300	
Pump: Haskel or Draeger	1	1	1	1			
Testers: RZ 25	1	1	1	1		1	
RZ 35	1	1	1	1		1	
Vehicle: Transport/Ambulance	1						

* Beaver Construction: Just starting a rescue program.

In the case of the Cape Breton Development Corporation (C.B.D.C.), mine rescue stations are established at each operating mine. Each station is staffed by a full time Station Superintendant and equipped with breathing apparatus, self rescuers and ancilliary mine rescue equipment, to meet immediate emergency needs of the mine. Technical and material support is available from other C.B.D.C. stations and backed up by the Provincial Mine Rescue Services. Actual training sessions are given by the Station Superintendant followed with certification by the Province upon successful completion of examination.

4.2.3 New Brunswick

Mine Safety and Mine Rescue is administered, under the Occupational Health and Safety Act, by the Chairman of the Occupational Health and Safety Commission.

An Executive Director of the Compliance Division attends to the activity of three branches:

a) Forest Safety
b) Industrial Safety
c) Mine Safety

The Mine Safety Branch is subdivided into three sections:

a) Mine Engineering
b) Mine Inspection
c) Mine Rescue

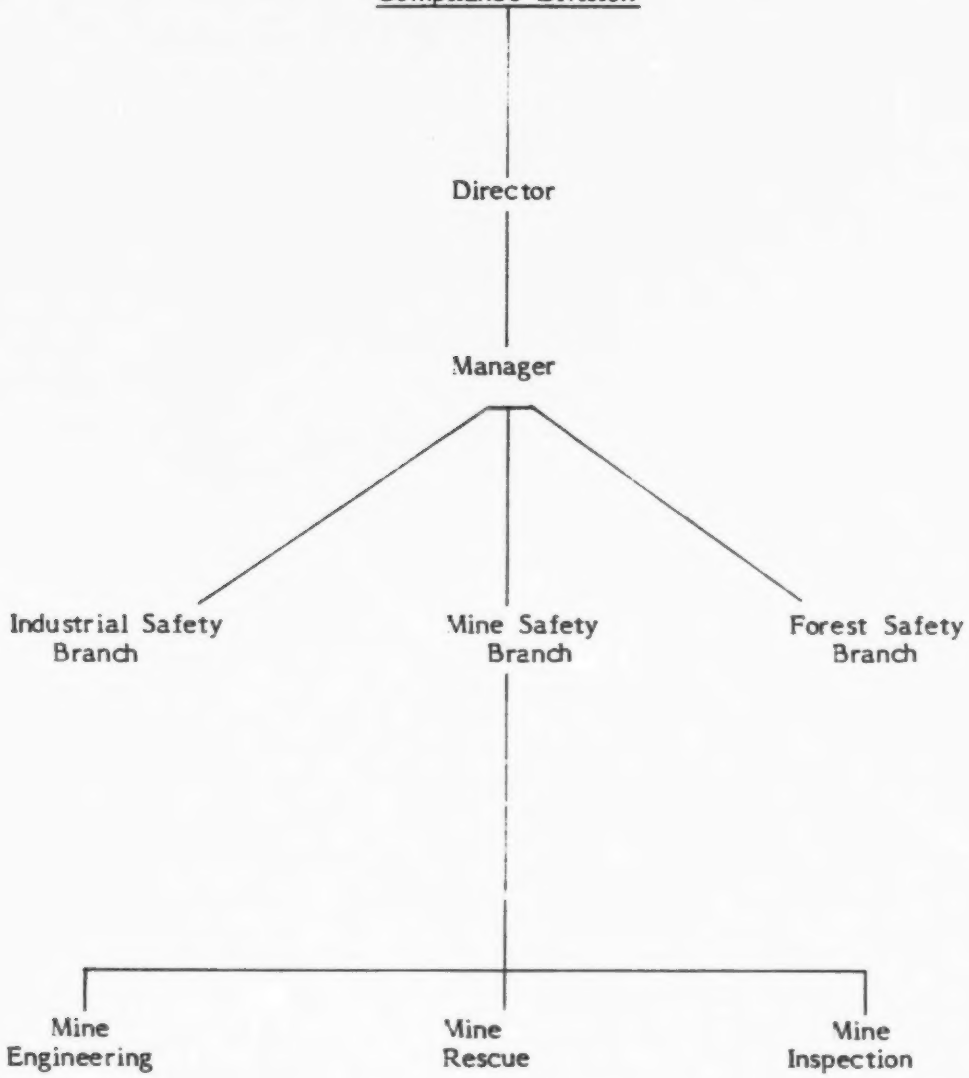
Figure 4.3, following, illustrates the administrative structure.

The New Brunswick government operates one mine rescue station located in Bathurst. It was established there during the early sixties when the

Figure 4.3

NEW BRUNSWICK

Occupational Health and Safety Commission
Compliance Division


Director
Manager
Industrial Safety Branch
Mine Safety Branch
Forest Safety Branch
Mine Engineering
Mine Rescue
Mine Inspection

only operating underground mine was in Bathurst. The station is patterned on the Ontario mode with living accommodations included for the Mine Rescue Supervisor and his family.

The station facility provides offices, classroom, repair workshop and indoor vehicle parking. The station maintains 20 sets of breathing apparatus, (BG 174 units) and a well organized, well stocked spare parts inventory. Permanent staff consists of one Mine Rescue Officer who, for the time being, also acts as Mine Safety Supervisor dealing with mine inspection.

The Mine Rescue Officer ensures that the operating companies comply with the legislation dealing with mine rescue. In the well established mining operations, mine rescue training is provided by company trained personnel. However, in the case of new operations, where "in-house" instructors are not yet available, training may be provided by the Mine Rescue Officer. In both cases, he has the responsibility of examining and certifying candidates for the various mine rescue certificates. The Mine Rescue Officer has at his disposal a mine rescue vehicle for the transportation of equipment, supplies and personnel. The geography of the Province and an excellent road system permits good access to all mine operations. The only Provincial Rescue Station is located in the north of the Province. Three of the four new mines being developed in the south are deep potash deposits situated several hours driving time from the rescue station. This time factor may be a cause for concern in the not too distant future.

In summary, the Provincial Government's long term policy is that mine rescue programs will be operated by each company's mine site personnel but closely monitored by the Mine Safety Branch. The equipment required to be maintained at each mine is given below.

Item	Number Required at each Mine
SCBA, BG 174	12
Oxygen Self Rescuers, SR30	6
Methanometers	2
Gas Detectors	2
Flame Safety Lamps	2
Absorbent (lbs)	500
Oxygen pumps	2
Cascade Oxygen Supply (cyliners)	4
Station testers RZ 25	1
RZ 35	2
Alkaline Canisters	24

4.2.4 Ontario

Mine Rescue in Ontario is administered by the Mining Health and Safety Branch of the Ministry of Labour. The Director of the Board supervises the Chief Mining Engineer who is responsible for mine inspection and mine rescue. The organizational structure for this group is shown on Figure 4.4.

The Province is divided into mining areas, and subdivided into Districts. Each mining area has a Mining Engineer and several District Mining Engineers under his authority. There were, at one time, about 120 District Engineers in Ontario. The mine rescue organization is supervised by a Senior Mine Rescue Officer who, like the Area Mining Engineers, reports to the Chief Mining Engineer.

The Province has established permanent mine rescue stations in each of the principal mining areas at the following locations:

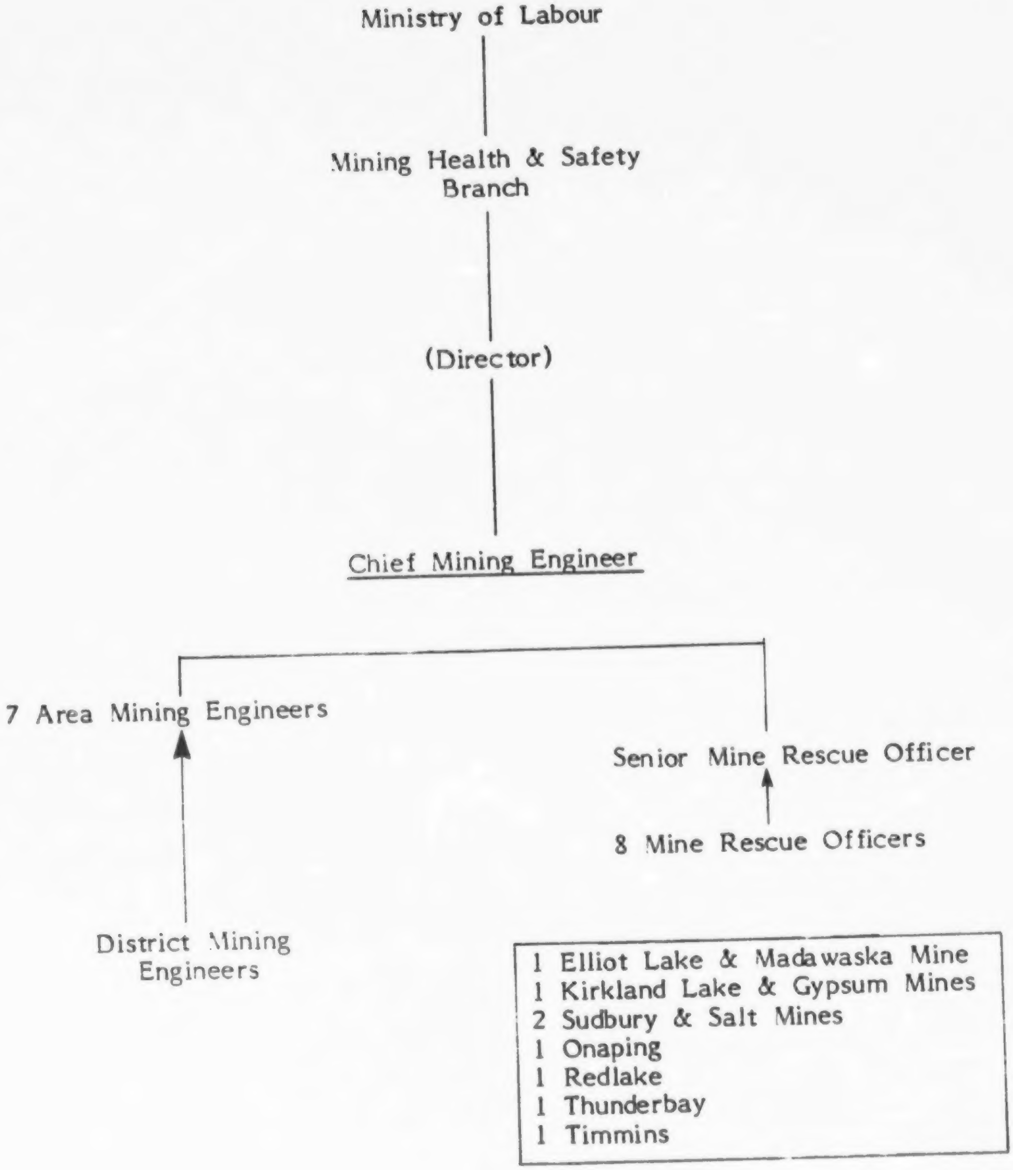
a) Sudbury

b) Elliot Lake
c) Onaping
d) Kirkland Lake
e) Thunder Bay
f) Red Lake
g) Timmins

At each rescue station there is a Rescue Training Officer who's work is to train mine workers and rescue teams in the use of apparatus and equipment used for mine rescue and firefighting. He is responsible for the care and maintenance of the equipment and apparatus lodged at the station and will assist other public bodies such as fire and police departments in their work. This would include servicing of breathing apparatus and providing advice when requested.

Figure 4.4

ONTARIO


Ministry of Labour
Mining Health & Safety Branch
(Director)
Chief Mining Engineer
7 Area Mining Engineers
Senior Mine Rescue Officer
8 Mine Rescue Officers
District Mining Engineers
1 Elliot Lake & Madawaska Mine
1 Kirkland Lake & Gypsum Mines
2 Sudbury & Salt Mines
1 Onaping
1 Redlake
1 Thunderbay
1 Timmins

The Mine Safety Director organizes the rescue teams at the mine site. A mine may have from two to eight rescue teams, depending on the size of the mine. There are between 800 and 1000 trained rescue workers available for mine rescue operations in Ontario. The quantity of mine rescue equipment available, and its location is on the following table. Mine operators must also provide some rescue equipment at the mine site.

District	Drager BG 174	Type N Masks	Demand Apparatus	Oxy SR 45	Rz 25 Rz 35	Leak Tester	Foam Generator
[1]Elliot Lake	51	50	13	14	3	16	3
[2]Kirkland Lake	58	24	6	12	5	18	2
Onaping	32	6	5	16	2	14	2
Red lake	56	8	6	15	4	17	1
[3]Sudbury	70	20	21	20	3	20	2
Thunder Bay	48	30	8	12	3	12	2
Timmins	42	15	7	13	3	16	2
Total	357	153	66	102	23	113	14

[1] Includes Madawaska Mine

[2] Includes Gypsum Mines

[3] Includes Salt Mines

4.2.5 Quebec

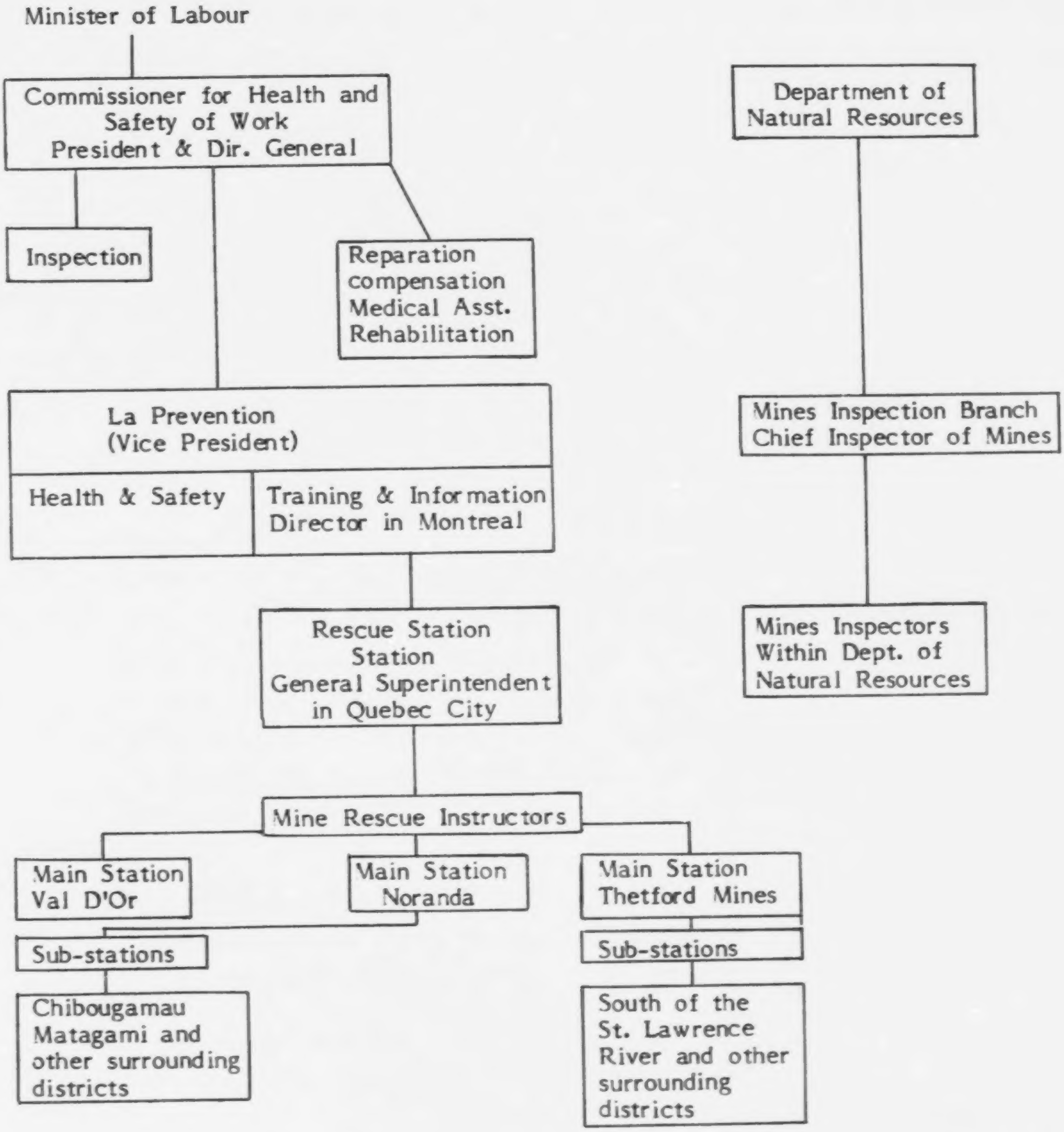
In the Province of Quebec, the administration of the Mine Rescue Service is very different from any of the other Provinces. There is a Provincial organization called the "Commission de la Sante et de la Securite du Travail du Quebec". (Commission of Health and Safety of Workers - C.S.S.T.). This commission has a Council of Administration, made up representatives of Unions and Employers; an administrative Committee; and a President/Director General. Executive Vice Presidents direct the operations of a number of areas of activity of which Inspection, Reparation, Administration and Prevention are the four main ones.

The mine rescue service comes under Prevention (See Figure 4.5). The General Superintendent of Mine Rescue supervises the activities of Mine Rescue Instructors who are employed by C.S.S.T. These instructors work at the main mine rescue stations and at the sub-stations. The Commission supplies all the mine rescue equipment and apparatus for the stations. The Mine Rescue Instructors maintain the equipment and provide training services for the mine rescue teams.

In the event of an emergency the operations of the rescue teams would be under the direction of the mine operator. This is the only case in Canada where mine rescue is not treated as a complete and integrated service which normally is involved with the actual emergency operations and offers advice to the mine operator and the mines Inspectors. It is possible, in time, that, if the isolation of the mine rescue service from the Mines Inspectorate continues (by being in different organizations) it would lead to a stagnation and lack of development of mine rescue because the General Superintendent and his staff have no formal contact with other government mining people concerned with mine safety, firefighting and emergency procedures. At present, no C.S.S.T. Inspectors have experience in either mining or mine rescue. They are currently required to attend basic mine rescue courses.

Figure 4.5

QUEBEC


Minister of Labour
Commissioner for Health and Safety of Work President & Dir. General
Inspection
Reparation compensation Medical Asst. Rehabilitation
La Prevention (Vice President)
Health & Safety
Training & Information Director in Montreal
Rescue Station Station General Superintendent in Quebec City
Mine Rescue Instructors
Main Station Val D'Or
Main Station Noranda
Main Station Thetford Mines
Sub-stations
Chibougamau Matagami and other surrounding districts
Sub-stations
South of the St. Lawrence River and other surrounding districts
Department of Natural Resources
Mines Inspection Branch Chief Inspector of Mines
Mines Inspectors Within Dept. of Natural Resources

In Quebec, there is approximately one trained mine rescue worker for every fifteen underground miners. Most mines maintain two rescue teams. In areas where a number of small mines are within easy reach of each other, only one team per mine is maintained. The C.S.S.T. provides funds for mine rescue expenses which are refunded by the mine operators on a "per employee" basis.

The quantity of equipment and apparatus maintained at the main and sub rescue stations are shown in Table 4.2.5 under the Thetford main station, the Agnico-Eagle sub-station and for all of Quebec.

4.2.6 Manitoba

Manitoba, like Ontario and Quebec, has no coal mines. All three of the Central Provinces have their mine rescue organizations directed, principally, towards the needs of hardrock mining.

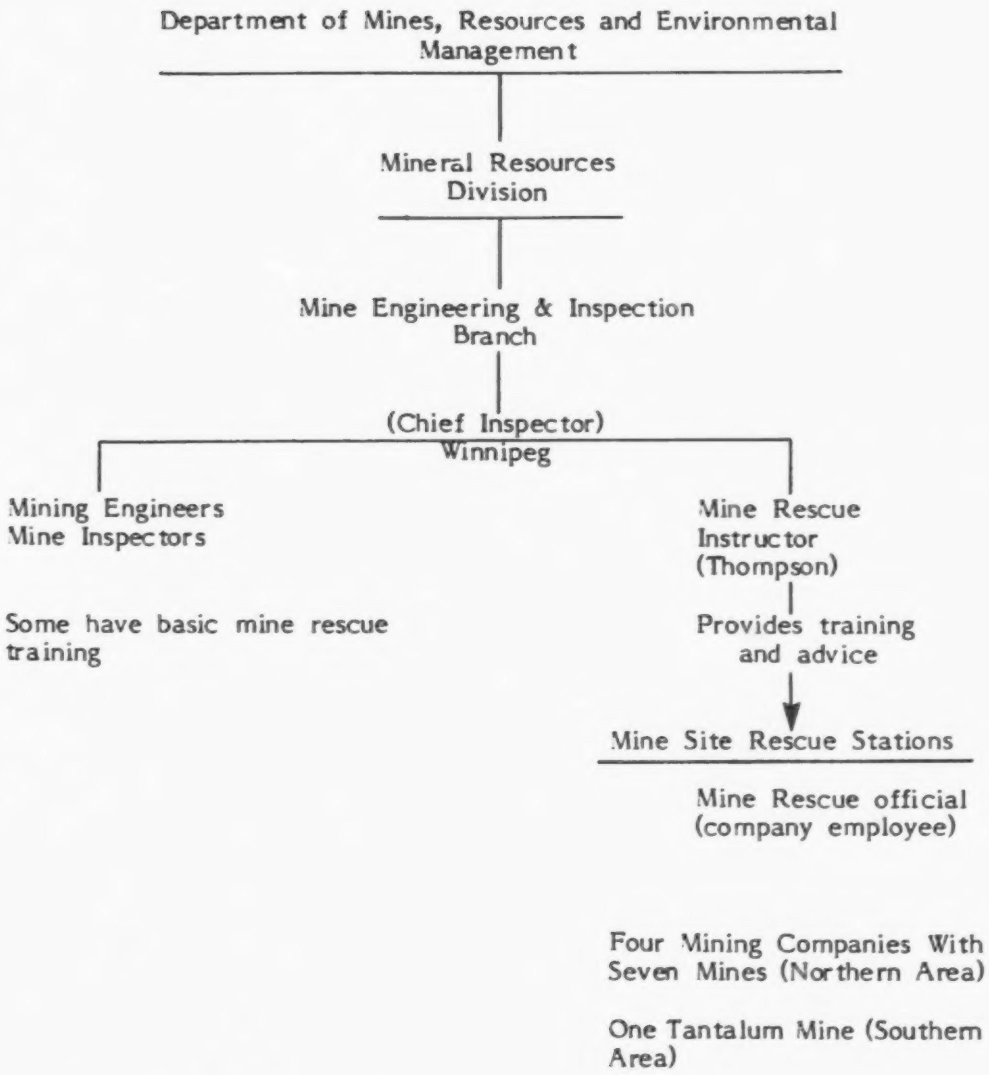
The organization of mine rescue is under the supervision of the Department of Mines, Resources and Environmental Management. Within this department is the Mineral Resources Division which has a Mine Engineering and Inspection Branch administered by a Chief Inspector. Figure 4.6 shows the structure of the organization. A Mine Rescue Instructor, who reports to the Chief Inspector, is responsible for arranging training courses, conducting examinations and ensures that the Chief Inspector's instructions regarding equipment and training are being carried out.

Mine rescue apparatus and equipment are provided by the Mining Company at its own expense. Each Company is required to provide personnel for training by the Government Mine Rescue Instructor.

MINE RESCUE EQUIPMENT		THETFORD MAIN STATION	AGNICO-EAGLE SUB-STATION	TOTAL FOR QUEBEC
DESCRIPTION	ITEM	Nº	Nº	Nº
DRAGER - BG - 174 COMPLET	BREATHING APP. DRAGER 174	18	6	139
CARTOUCHE PRÉPARÉE D'AVANCE POUR CO^2	PRE-PREP. CO_2 CANNISTERS	66	16	-
ABSORBANT CO2 -	CO2 ABSORBANT	274 Kg	90 Kg	
CYLINDRE DE RÉSERVE BG-174	BG174 RESERVE CYLINDERS	25	12	216
APPAREIL DE CONTRÔLE RZ-25	CONTROL APPARATUS RZ-25	2	1	16
APPAREIL DE CONTRÔLE INDIVIDUEL D'ÉTANCHÉITÉ RZ-25	INDIVIDUAL R35 - 40 etc.	12	6	108
OXY-SR-45 COMPLET	SELF RESCUERS SR-45	17	4	121+ 81 CYL
APPAREIL À AIR COMPRIMÉ	BREATH APP. COMP. AIR SCOTT MSA	3	1	43
SYSTÈME ÉGALISATEUR POUR APPAREIL À AIR	EQUALIZER FOR COMP. AIR APP	3	1	32
MASQUE À GAZ "ALL SERVICE"	GAS MASK - ALL SERVICE	17		235
CARTOUCHE POUR MASQUE À GAZ TYPE «N»	CANNISTER FOR TYPE "N" MASKS	36		435
AUTO-SAUVETEUR W 65	TRAINING SELF RESCUERS	1		
APPAREIL DE RESPIRATION ARTIFICIELLE	APP. FOR ARTIF. RESPIRATION	2		39
APPAREIL DE RÉANIMATION	APP. FOR RESUSCITATION (INHALER)			8
GÉNÉRATEUR DE MOUSSE	FOAM GENERATOR (M.S.A)	1		3
LAMPE DE SÛRETÉ À FLAMME	FLAME SAFTY LAMP	4	1	83
DÉTECTEUR DE GAZ	GAS DETECT. DRA. - MH. - PK.	7	1	65
GÉNÉRATEUR DE FUMÉE	SMOKE GENERATOR	30		
ENSEMBLE DE TÉLÉPHONE	TELEPHONE APP.	3	1	24
BOBINE AVEC CÂBLE TÉLÉPHONIQUE	TEL CABLE REEL	6	2	45
CÂBLE GUIDE	LIFE LINE	1		7
[illegible] D'ATTACHE À 2 FERMOIRS	LIFE LINE CONNECTORS	18	4	90
CEINTURE DE SÛRETÉ AVEC ANNEAU EN «D»	SAFTY BELT. "D" LINK	21	6	136
BRANCARD - PANIER	STRETCHER	3	1	108
GROS CYLINDRE D'OXYGÈNE	LARGE OXY. CYLINDER	4		59
GROS CYLINDRE D'AIR	LARGE AIR CYLINDER	7		69
SÉCHOIR A BOYAUX	DRYER FOR HOSES ETC.	4		21
ROULOTTE 719		1		
CAMION	VEHICLE	1		2

Figure 4.6

MANITOBA


Department of Mines, Resources and Environmental Management
Mineral Resources Division
Mine Engineering & Inspection Branch
(Chief Inspector) Winnipeg
Mining Engineers Mine Inspectors
Some have basic mine rescue training
Mine Rescue Instructor (Thompson)
Provides training and advice
Mine Site Rescue Stations
Mine Rescue official (company employee)
Four Mining Companies With Seven Mines (Northern Area)
One Tantalum Mine (Southern Area)

Two, five men rescue teams are normally available per underground mine. Large mines, such as the Inco Mine at Thompson have as many as four teams. Where there are a number of small mines operating fairly close together, they combine their resources and between them will have three or four teams. Much depends on the level of mining activity. The current level of mining activity at the mine is well below normal levels but about five years ago when activity was greater, the following quantities of equipment and numbers of trained men were available at the mine.

Drager BG-174: units 118, spare bottles 116, pre-fill Can. 125.
Oxygen Self Rescuers: 30 min 9, 45 min. 22, spare bottles, 13/30 & 10/45.
Thirty Minute Demand: 10 M.S.A., 12 scott
Oxygen Pumps: Three type U-200 and one hand pump
Chemox App: 33
RZ Testers: Type 25, 7; Type 35, 7.
High Expansion Foam Generators: One-Inco
Porta Phone: 5 units
Type 'N' Masks: 118 M.S.A. and 6 Wilson

Gas Detectors:	flame safety lamps	27
	multigas	27
	methane	5
	explosion meters	10
	oxygen analyser	5
	Persons trained and active	108
	Number of teams	9

The Ruttan open pit mine operates a surface mine rescue team. Each rescue team consists of six trained surface rescue workers.

4.2.7 Saskatchewan

In the Province of Saskatchewan there is an Occupational Health and Safety Branch answerable to a Deputy Minister in the Provincial Department of

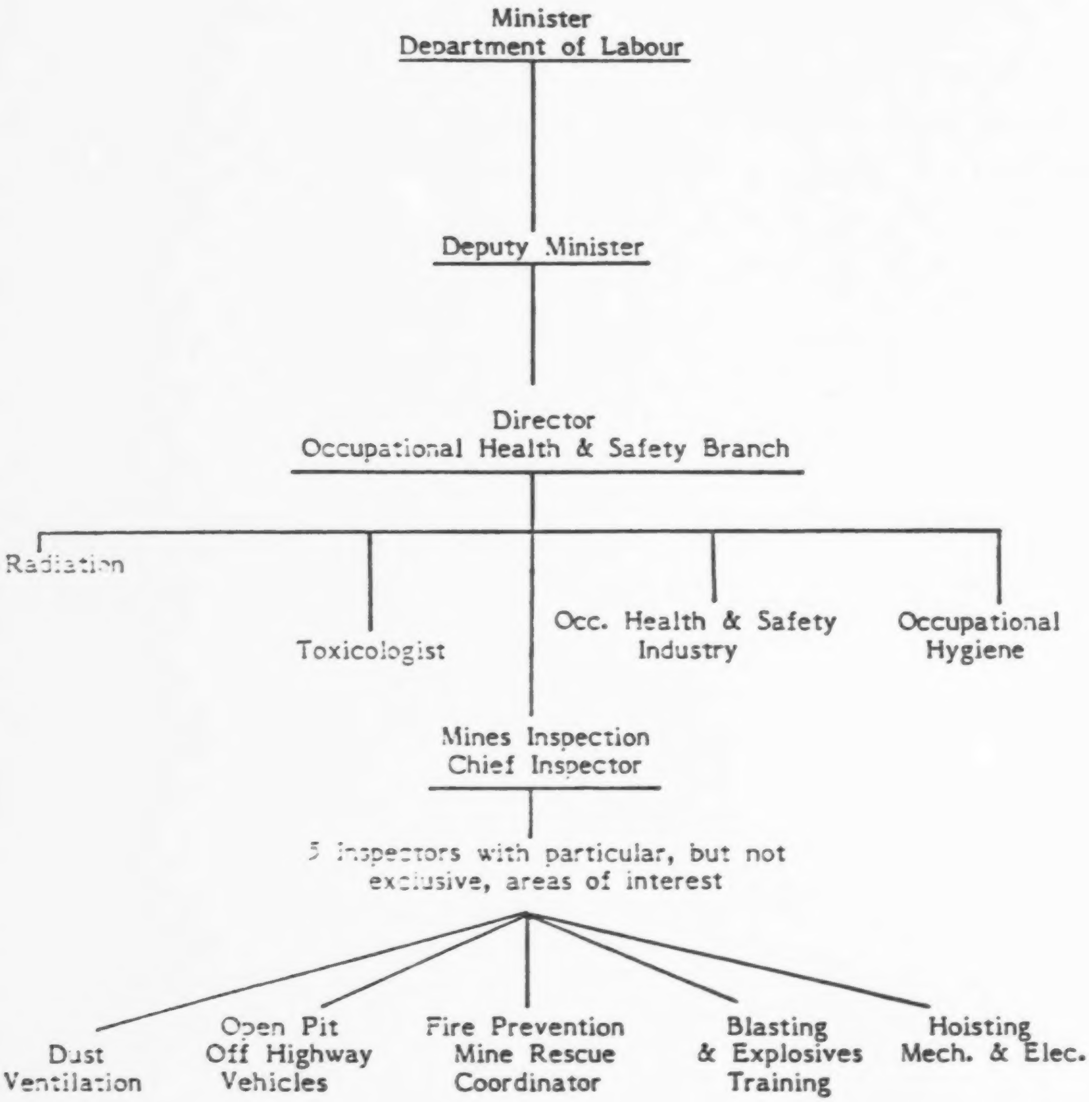
Labour. The Director of Occupational Health and Safety is responsible for the operation of the Branch and has the following sections report to him:

a) Radiation monitoring
b) A toxicologist
c) Occupational Hygiene
d) Occupational Health and Safety (Industrial)
e) Mines Inspection.

The Mines Inspection group consists of five Mine Inspectors (Figure 4.7) under the immediate supervision of a Chief Inspector of Mines.

Figure 4.7

SASKATCHEWAN


Minister
Department of Labour
Deputy Minister
Director
Occupational Health & Safety Branch
Radiation
Toxicologist
Occ. Health & Safety
Industry
Occupational
Hygiene
Mines Inspection
Chief Inspector
5 Inspectors with particular, but not
exclusive, areas of interest
Dust
Ventilation
Open Pit
Off Highway
Vehicles
Fire Prevention
Mine Rescue
Coordinator
Blasting
& Explosives
Training
Hoisting
Mech. & Elec.

The Occupational Health and Safety Act provides for the making Regulations and for the appointment of officers. Part IX of the Mines Regulations sets out the general organization of mine rescue which includes the setting up and equipping of mine rescue stations; responsibility for the operation and maintenance of the stations; the certification of persons competent in rescue work, rescue instruction, and emergencies; numbers of people to be trained and supervision of mine rescue operations. The responsibility and duties of the Chief Inspector and the mine employer are given in guideline form in Appendix III, Section 3.4.1, "The Mines Regulations", Part IX, Reg. 418.00 - 418.16.

In the organization of mine rescue services, Saskatchewan takes into account the diversity of mining operations. In the north of the Province, there are uranium hard rock mines varying in size between mines like Cluff Lake, with no more than 100 persons underground, and developments like Keylake which has potential for around 450 underground workers. In the Saskatoon and Esterhazy areas there are deep shaft potash mines and in the extreme southeast, near Esteven there are lignite strip mining operations. Certain dangers are also associated with hazardous materials used in the mineral processing plants such as soda ash, ammonia and sulphuric acid.

The Mine Inspector responsible for coordinating mine rescue is stationed in Saskatoon where the Mines Inspection Branch maintains "four hour" breathing apparatus sufficient to equip a six-man team. In addition there is associated monitoring equipment and ancilliaries for use in training.

It is the responsibility of the mining companies to enlist, train and make readily available the number of rescue teams which the Chief Inspector deems necessary. Normally this consists of a minimum of 12 people in two teams, one to be operating while the other is on standby. Where mines are in isolated areas, as was the case with Eldorado Mining, a minimum of 36 trained persons, forming 3 teams, are required. Each mine provides a Mine Rescue Instructor who has been trained by the Mine Rescue

Coordinator. Mines Branch seminars for Mine Rescue Instructors are held annually. The term "readily available", as it applies to mine rescue teams means, to avoid the possibility of team members being on different shifts or in the mine when the emergency arises.

It is the responsibility of the Chief Inspector (who is aided by Rescue Coordinator) to examine and certify as competent, mine rescue workers and instructors, and supervisors of emergency procedures. There are at present 17 certified Mine Rescue Instructors in the Province.

In summary, the policy and organization for mine rescue in Saskatchewan is that the mining companies are responsible for training and equipping their own mine rescue teams according to standards set by the Chief Inspector. The Chief Inspector's department, (the Mines Inspection Branch), assists by providing training for Mine Rescue Instructors and by providing training manuals, examination and certification. The Chief Inspector is then responsible for ensuring that his standards are met by having regular inspections made by his staff. There are no requirements for mine rescue at open-pit or strip mines in Saskatchewan.

The following table lists typical examples of the equipment required to be held at Mine Rescue substations (at mine sites):

	At Potash Mines	Hardrock Eldorado Mines Group	Cenex Mines Group
4 hour self contained units	10	15	5
short duration self Contained self rescuer	10	15	5
Resuscitators	2	15	5
Stretchers	2	3	1
First aid boxes	2	3	1
Spare oxygen (equivalent bottles)	15	*15	5
Spare absorbent (equivalent canisters)	15	30	5

Every substation should have access to an RZ tester for checking the 4 hour units and suitable emergency communication systems set up.

Further examples of rescue equipment maintained at a Potash Mine and at Government Rescue Stations are given on the following pages.

CANADIAN MINE RESCUE

Location of Mine Rescue Equipment

Rescue Station Area:
[illegible]
Potash Division
Vanscoy, Sask.

Personnel to Contact:
Name: [illegible] Tel.# [illegible]
Name: [illegible] Tel.# "

	MINES	GOVERNMENT
Draeger BG174 Apparatus	10	
Draeger 4-hour Canisters	30	
Aerorlox Apparatus		
Liquid O_2 Flasks		
McCaa Apparatus		
LBS of CO_2 Absorbent	200	
Chemox Apparatus	4	
Chemox Canisters		
BIO Paks		
Draeger SR45	8	
Draeger SR60		
Other Self Contained SR's		
Demand Breathing Apparatus (STD)	4	
Demand Breathing Apparatus (CMR)		
Jumbo Air Cylinders (300 cu. ft.)		
Type N Gas Masks	6	
Type N Canisters	6	
H.E. Foam Generators		
Foam (Gals.)		
O_2 Pumps	1	
Air Compressors		
Draeger - Rz 25 Testers	1	
Draeger - Rz 35/40 Testers		
Spare O_2 Cylinders - BG174	20	
- SR45	2	
- BIO Pak		
- McCaa		

U/G Mine Rescue Vehicle

Date: January, [illegible]

CANADIAN MINE RESCUE

Location of Mine Rescue Equipment

Rescue Station Area:
Department of Labour
Saskatoon, Saskatchewan

Personnel to Contact:
Name: Tel.#
Name: Tel.#

	MINES	GOVERNMENT
Draeger BG174 Apparatus		6
Draeger 4-hour Canisters		6
Aerorlox Apparatus		
Liquid O_2 Flasks		
McCaa Apparatus		
LBS of CO_2 Absorbent		36
Chemox Apparatus		
Chemox Canisters		
BIO Paks		
Draeger SR45		3
Draeger SR60		
Other Self Contained SR's		
Demand Breathing Apparatus (STD)		
Demand Breathing Apparatus (CMR)		
Jumbo Air Cylinders (300 cu. ft.)		
Type N Gas Masks		
Type N Canisters		
H.E. Foam Generators		
Foam (Gals.)		
O_2 Pumps		1
Air Compressors		
Draeger - Rz 25 Testers		1
Draeger - Rz 35/40 Testers		
Spare O_2 Cylinders - BG174		7
- SR45		
- BIO Pak		
- McCaa		

Date: January, 1983

4.2.8 Alberta

Mine rescue in Alberta is provided for under Chapter 18, Part 3, Section 30 of the Coal Mines Safety Act which places the onus on the mine manager to provide a rescue station, a qualified rescue training officer, rescue teams and prescribed equipment, to the satisfaction of the Department of Occupational Health and Safety who administers the Act. In addition to the Act, there are the Coal Mines Safety Regulations made under the Act. These Regulations define in more detail what the owner of a mine must provide in terms of equipment and apparatus, maintenance of equipment, trained personnel and duties of a Mine Rescue Training Officer. These same Regulations enable the Department of Occupational Health and Safety to specify where supplementary rescue stations are required. The Regulations also make the Department responsible for supervising mine rescue training programs, for conducting examinations and granting certificates; and for making inspections of Mine Rescue Stations. Figure 4.8, shows the structure of the Department of Occupational Health and Safety, as it relates to mine rescue.

Under the provisions of the Coal Mines Safety Regulations, Reg. 72, the operators of surface mines are being encouraged to strengthen their mine site emergency organization, though at this time, a surface mine rescue team is not a requirement. So far as underground mines are concerned, Alberta has only five underground mines, all coal, one is temporarily closed, three are in the early stages of development, and one is in operation (it consists of two medium sized underground coal mines).

Alberta has several mine rescue problems:

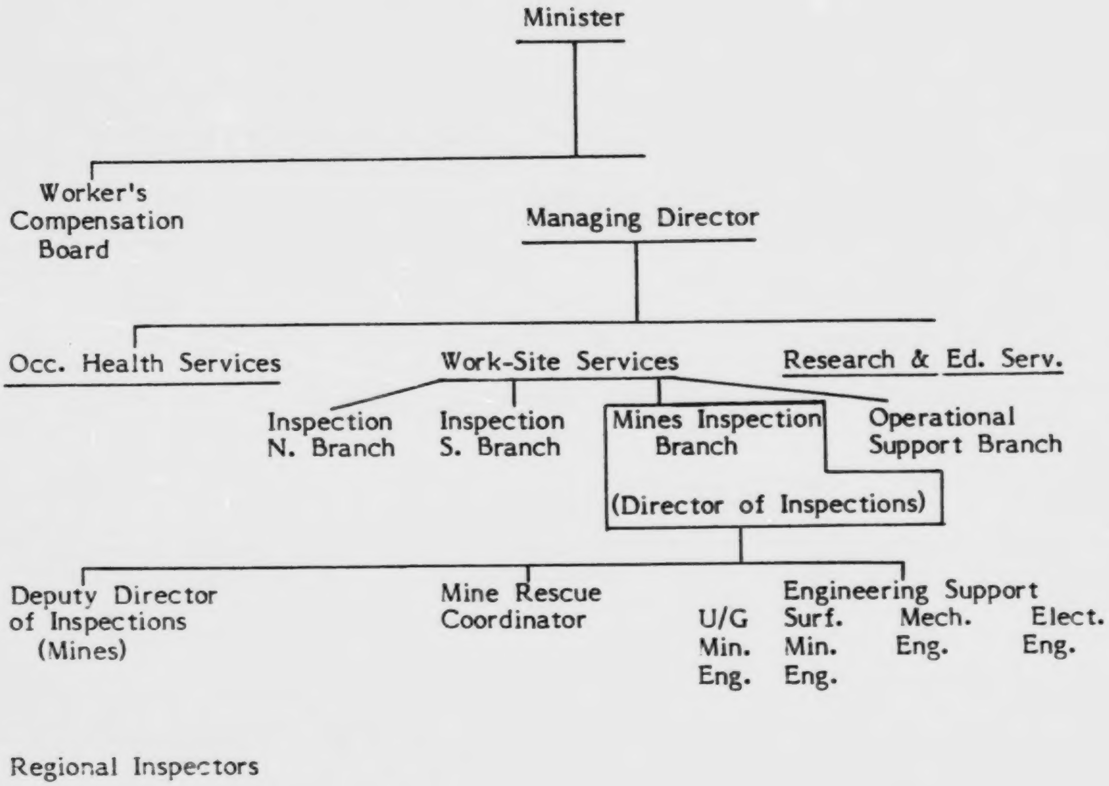
a) Mines with rescue stations are widely separated, by at least two hours driving time.

b) There are, at times, numerous small coal exploration adits being driven which are often in areas of difficult access.

Figure 4.8

ALBERTA

Worker's Health Safety and Compensation


Minister
Worker's Compensation Board
Managing Director
Occ. Health Services
Work-Site Services
Research & Ed. Serv.
Inspection N. Branch
Inspection S. Branch
Mines Inspection Branch
Operational Support Branch
(Director of Inspections)
Deputy Director of Inspections (Mines)
Mine Rescue Coordinator
Engineering Support
U/G Min. Eng.
Surf. Min. Eng.
Mech. Eng.
Elect. Eng.
Regional Inspectors

c) There are tunnels being driven in the City of Edmonton for extensions to the City's rail transit system. At this time the City of Edmonton has more miles of tunnel in use than the mines. In the Edmonton area, coal seams occasionally occur near the surface so that, under certain conditions, methane gas can enter the tunnel drivage. As a result of this, it has been proposed that a rescue station would be administered by the City Fire Department and mining type breathing apparatus would be purchased. The Occupational Health and Safety Department would provide the rescue station and a Training Officer.

When a mine is asked to send part of its mine rescue apparatus and personnel to assist another mine, the Department's approval must first be obtained before a rescue team can leave its home base. The Regulations are unspecific and don't address the problem of how to dispatch a mine's rescue team when an emergency arises in a small exploration drivage. The final decision which is made at the time depends on the nature and location of the emergency, and is made by the Director of Inspections (Mining) in consultation with the mine in question.

The proportion of trained personnel in Alberta is about 15% of the number of underground workers. This is due to a small underground workforce. Since the Surface Rescue Program has only been recently started, the percentage of trained surface rescue personnel is still minimal. However, about 150 persons were awarded Surface Rescue Certificates during 1982.

The quantity of equipment in use. All underground operations maintain limited supplies of equipment, depending on the size of the operation. The minimum number of 2-4 hour breathing apparatus is 12 per mine. Each surface operation provides its own coverage and the level of equipment is entirely dependent on the particular hazards at each operation.

The level of supplies and spares. Each underground and surface operation is, at present, responsible for its own supply of spares. However, the quantities maintained are minimal. The Government is looking into the feasibility of providing emergency back-up supplies for underground operations.

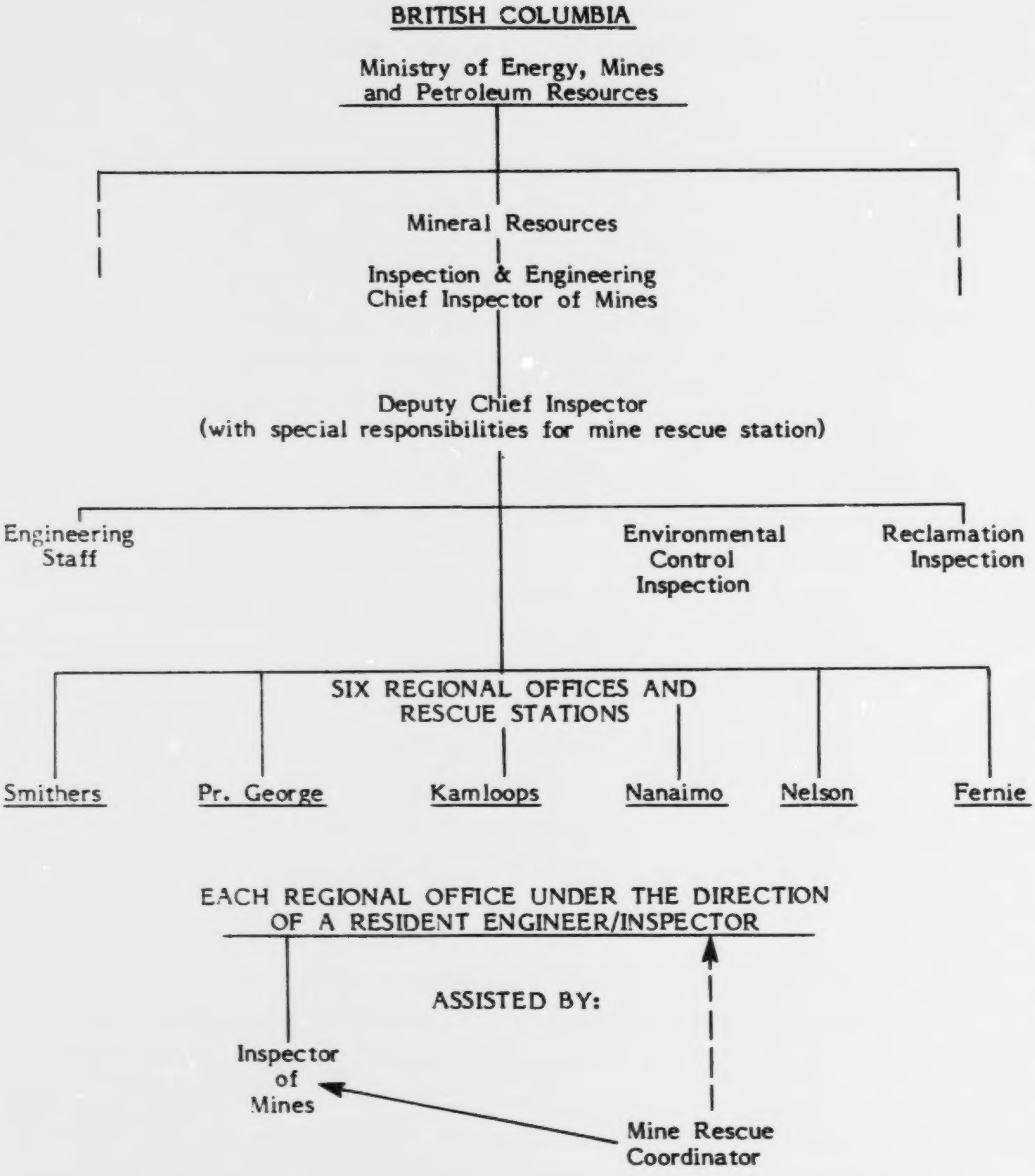
The mine rescue organization in Alberta is based on a philosophy similar to that of Saskatchewan, which is, that the mines are responsible for providing teams, equipment, apparatus, and training. The Department establishes the standards, provides training manuals, examines and certifies the competency of workers for mine rescue. It also monitors the rescue organization to ensure that the required standards are being met.

4.2.9 British Columbia

Mine rescue organization in British Columbia is provided for under the two Acts, The Coal Mines Regulation Act which applies to coal mines, and the Mining Regulation Act which applies to other mines. Both Acts are administered by the Ministry of Energy, Mines and Petroleum Resources. A Chief Inspector of Mines is appointed, aided by a Deputy Chief Inspector, to head the Inspection and Engineering Branch (Figure 4.9) which deals with mines inspection and mine rescue.

The Province is divided into six mining regions. Each region has a permanent office and mine rescue station located in a town or city close to the mining operations.

Figure 4.9


BRITISH COLUMBIA
Ministry of Energy, Mines and Petroleum Resources
Mineral Resources
Inspection & Engineering
Chief Inspector of Mines
Deputy Chief Inspector
(with special responsibilities for mine rescue station)
Engineering Staff
Environmental Control Inspection
Reclamation Inspection
SIX REGIONAL OFFICES AND RESCUE STATIONS
Smithers
Pr. George
Kamloops
Nanaimo
Nelson
Fernie
EACH REGIONAL OFFICE UNDER THE DIRECTION OF A RESIDENT ENGINEER/INSPECTOR
ASSISTED BY:
Inspector of Mines
Mine Rescue Coordinator

Each rescue station is under the direction of a Mine Rescue Coordinator who reports to, and works closely with, the Inspector of Mines, but is also responsible to the Resident Engineer. The Rescue Coordinator has the following duties:

a) to maintain all emergency apparatus and support equipment held at the station

b) to inspect equipment, apparatus, and the rescue facilities maintained at the mines

c) to provide training and instruction to company rescue instructors who train mine site personnel and teams.

Although the Regional Mine Rescue Stations are permanent, they do not have permanent rescue teams on staff. The rescue stations maintain the following mine rescue apparatus and supplies:

a) 43 units of 4 hour breathing apparatus

b) 59 units of 3 hour liquid oxygen apparatus

c) 24 units of positive pressure self rescuers

Plus - ancilliary equipment and first aid supplies

The stations do not have vehicles to transport equipment and apparatus to the mines. It is assumed that the mine who needs the equipment will transport it.

The B.C. Ministry of Energy, Mines and Petroleum Resources (E.M. & P.R.) finances the cost of operating the six regional stations. They also finance the preparation and printing of training manuals for use in the industry.

The apparatus and equipment and numbers of teams available at each mine are ordered by the Inspector according to standards and guidelines established by the Chief Inspector's department. The apparatus and equipment at the six Provincial rescue stations are available as back-up to the mine equipment should it be needed. Mines Inspectors can also offer advice and provide assistance to mine management when requested.

In summary, the Province of B.C. requires mine operators to provide the necessary mine rescue equipment and train personnel according to Provincial standards established by the Chief Inspector of Mines. Maintenance of these standards is monitored by inspection. The Engineering and Inspection Department provides training manuals and training for mine instructors in addition to backup rescue equipment in cases of emergency.

4.2.10 Yukon and N.W.T.

Mine rescue is the responsibility of the Federal Government and is administered by the Department of Indian and Northern Affairs. A Chief Inspector is appointed and has a Mine Rescue Superintendent under his direction. There are mine rescue stations established in Whitehorse and Yellowknife. The Territorial Government supplies apparatus and ancilliary equipment to the mines. The operator would also supply some equipment.

In the Yukon, the Rescue Superintendent advises and assists with the training and certification of rescue workers and maintains all equipment and apparatus. Each mine is required to supply trained rescue personnel. Two teams are usually required.

Equipment in the Yukon

All major mine rescue equipment is supplied by the Federal Government. The following apparatus is maintained in the Yukon.

Drager B.G.-174

A total of 44 Drager B.G.-174 are owned by the Department of Indian & Northern Affairs, Canada. Of these: 8 are on loan to the Government of the N.W.T. The remainder are located at the following locations:

12 at U.K.H. Mine
12 at Whitehorse Copper Mines
12 at Mine Rescue Station - Whitehorse

Scott Air Pak

The Department owns 14 Air Paks. All have been converted to model IIa standard. The remaining equipment are located at:

of these:
4 at Whitehorse Copper Mines
3 on loan to M.O.T. Depart. Fire fighters
5 at Mine Rescue Station - Whitehorse
2 at U.K.H. Mine

Drager Oxy 45 - Self Rescuers

The Department owns 24 of these. The remainder are at:

6 at Whitehorse Copper Mines
7 at U.K.H. Mine
11 at Mine Rescue Station - Whitehorse

Other Equipment

1 Oxygen booster pump at station
1 Oxygen booster pump at U.K.H.M.^c
1 Hand booster pump at Whitehorse Copper Mines

1-6000 CFM high expansion foam generator at the Station
1 Portable - gasoline powered air compressor at the Station
1 Electric air compressor at U.K.H.M.

Apparatus testers, multigas detectors etc. are on hand at all locations

The inventory of mine rescue equipment is valued at approximately $400,000.00.

In the N.W.T., a mine must be equipped with sufficient apparatus and trained personnel to be able to carry out rescue work continuously with three teams. This means 16 trained men, though most mines have about 40. In total, the N.W.T. has about 250 trained rescue workers and 174 B.G. 140 self-contained sets of breathing apparatus. The mine operators provide additional apparatus such as Scott Air Paks as well as an Assistant Mine Rescue Superintendent who trains the mine site teams at the mine.

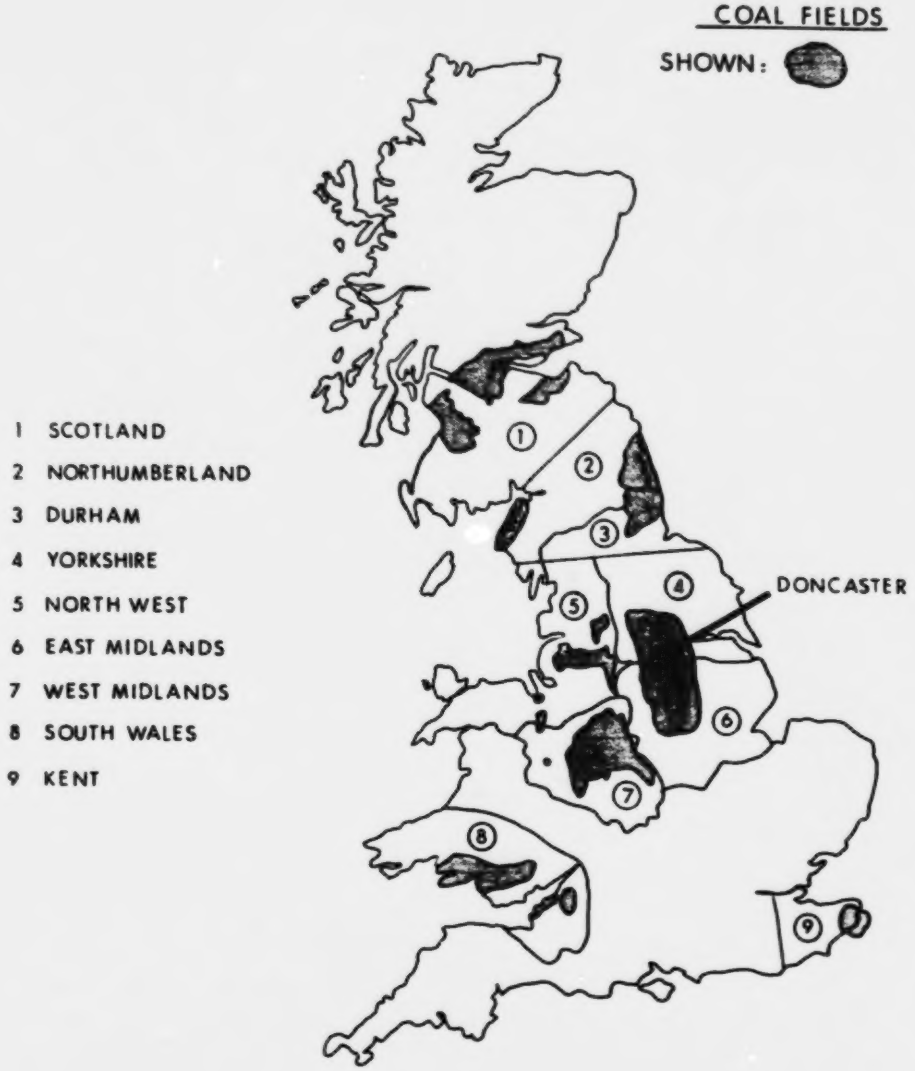
4.3 UNITED KINGDOM

The mining industry in the United Kingdom has both surface and underground coal mines operated by the National Coal Board (NCB). The NCB was formed following the Nationalization Act of 1947 to administer all aspects of the British coal industry.

The Board administers nine coalfields. Their locations are shown on Figure 4.10.

The total coal production from the U.K. coalfields is approximately 120 million tons (annual) which includes 15 million tons from opencast operations. Over 200,000 persons are engaged in work relating to coal production. The largest concentration of underground coal mines is located in Yorkshire

FIGURE 4 - 10


COAL FIELDS
SHOWN:
1 SCOTLAND
2 NORTHUMBERLAND
3 DURHAM
4 YORKSHIRE
5 NORTH WEST
6 EAST MIDLANDS
7 WEST MIDLANDS
8 SOUTH WALES
9 KENT
DONCASTER
①
②
③
④
⑤
⑥
⑦
⑧
⑨

THE BRITISH COALFIELDS
ADMINISTRATIVE AREAS

near Doncaster. It has over 60 producing mines in the immediate area. Headquarters for the National Coal Board Mines Rescue Service is also located at Doncaster and is presently headed by Mr. Peter Hallam, General Manager.

Mine rescue practice in the U.K. is based upon the findings and report of a Department Committee on Mine Rescue Work, 1926. This report provided the background for legislation which recognizes two fundamental components:

a) provision of trained men and equipment
b) an organizational framework at the mine, capable of providing control and direction to mine rescue operations.

The "Coal and Other Mines (Fire and Rescue) Regulations 1956 - S.I. 1956 No. 1768, recognized the importance of these two functions. An organization has now been established to conform to these Regulations and to provide assistance to meet the needs of Mine Rescue in the U.K.

The Regulations, given in Appendix III Section 3.5.1, are administered by the Health and Safety Executive.

4.3.1 Health and Safety Executive

The Health and Safety Executive functions under the direction of a Health and Safety Commission which is composed of 8 appointed Commissioners who advise the Minister in matters of Industrial Safety under the Health and Safety at Work Act 1974. This legislation incorporated all previous "Worker Safety Acts" under one administration. The Health and Safety Executive is responsible for the administration of this Act (1974) of which mine safety and the Coal and Other Mines (Fire and Rescue) Regulations 1957, is a part.

The administration of Mine Safety Regulations is directed by a Chief Inspector, assisted by 3 Principal Inspectors in charge of various areas or regions. These in turn are supported by District Mine Inspectors. In each area one inspector is designated to be responsible for the inspection of mine rescue facilities. Inspection schedules depend upon need, but rarely exceed 2 times per year. Typically, such an inspector would be holder of a subsisting certificate in mine rescue and be capable of using self contained breathing apparatus if required. British Law is written so as to place the onus of mine rescue functions upon mine management so that the inspector's role is one of program monitoring and participation in "Incident Control".

4.3.2 Organization

The Mine Rescue Organization required for British mines is set out in considerable detail. Since copies of the appropriate sections of the Regulations are provided in Appendix III, there is little point in repeating them here. However, it is worth noting that the owner or mine operator, that is the N.C.B., in order to meet its obligations operates a number of strategically located permanent Mine Rescue Stations.

Many of these stations were originally set up by Regional Associations of Coal Mine Operators following the 1926 Department Committee Report on Mine Rescue Work. This was twenty years before the N.C.B. was formed. One of the reasons that the owners responded so readily, apart from a humane responsibility to their employees, was their recognition of the value of mine workers trained in the use of breathing apparatus. The trained mine workers were an important means of helping to protect the mine property and workings. This was particularly true of the Yorkshire and West Midland regions, where it was sometimes necessary to seal off sections of the mine in which spontaneous heating of the coal had occurred. This kind of work has always been part of the mine rescue team function and is specifically provided for by a proviso in the U.K. Regulations, Part III, 11 (2).

The permanent, central mine rescue stations are provided, equipped and staffed at the owners expense. The Station is under the control of a Superintendent and at least two or three Instructors, one who acts for the Superintendent in his absence. Though the Regulations do not demand it, it is usual for the central rescue stations (referred to as an 'A' station) to have permanent, resident, six man, rescue corps in addition to the Superintendent and his deputy. In addition to the permanent corps, each mine is required to have rescue workers who have trained at the 'A' station and are accustomed to working with the permanent corps members. If the facilities of a permanent rescue station do not include a permanent corps, (referred to as a 'B' station), the mines depending on their size, must arrange to have one, two or three, 5 man rescue brigades.

The mine rescue requirements for other types of mines are covered by the same Regulations as for coal. If such a mine is less than 20 miles from the nearest NCB Mine Rescue Station, it normally enters into a contractual arrangement with the NCB for the provision of rescue services, for both training and equipment supply. If situated further than 20 miles, a substation is established at the mine. The equipment is also maintained here.

The quantity of equipment and apparatus to be maintained is given below in Regulation 23 (equipment at central rescue stations) and in Regulation 24 (equipment at mines). The number of men to be trained and held in a state of readiness is given in 15, 16, 17 and 18 of Appendix III, Section 3.5.1.

Apparatus

Regulation 23 — Equipment at Central Rescue Station

a) 20 units plus necessary oxygen for 48 hours supply

b) 4 smoke helmets (hose masks)

c) 4 reviving apparatus plus necessary O_2

d) first aid equipment
e) safety lamps and 6 flame safety lamps
f) birds
g) motor vehicle
h) portable signalling device
i) means for gas testing training

Regulation 24 — Rescue equipment at mines with more than 100 persons employed

a) 1 smoke helmet
b) reviving apparatus plus necessary oxygen
c) 1 electric lamp and flame safety lamp for each trained man

Note: Breathing Apparatus to be kept at stations not at mines.

A more complete discussion on the organization of mine rescue in the U.K. is given in Appendix IV, Section 4.3.

4.4 FEDERAL REPUBLIC OF GERMANY

General

Contact with Mr. Franz Josef Kock, Head of the Mine Rescue Centre in Essen, was made by telex requesting his help in providing information. Fourteen documents were received, all in German. Translations were made and a summary of the information in Appendix IV, Section 4.4, Part A, Enclosures No. 1 to 5. In addition, Part B of Appendix IV contains the complete text of Mr. Kock's presentation at the International Symposium on Crisis Management held at Sydney, N.S., October 19-21, 1982. The information below is a summary of these papers.

Mine Rescue Centre, Essen

The Mine Rescue Centre in Essen provides mine rescue facilities for 28 coal mining operations and one rock salt mine. A total of 90,000 miners produce over 70 million tons of coal annually. The workings are, on average, 900 metres deep and are known to be gassy (10 m^3 to 90 m^3 CH_4 per ton of coal). The Centre was established in 1910 with the objective of improving the organization and execution of mine rescue programing in West Germany.

Team Organization

The establishment of mine rescue teams is required by law, however, participation by individual members is voluntary. Within the Ruhr coalfield 3000 persons are trained in Mine Rescue. This represents 36 teams of 80 persons or 3.3% of the workforce.

The term "Brigade" is used describe the entire mine rescue group at a mine or Rescue Station.

At each large mine, the Bridgade consists of the following people:

1	Commander (or superintendent)
3	Vice Commanders (or assistant superintendents)

The typical brigade would also have approximately 10 rescue teams with each team having a section leader (captain) and 4 men. Support personnel are also required:

a) Chief Apparatus Maintenance Supervisor
b) Maintenance personnel

Other support personnel which are part of regular brigade:

a) surveyors
b) ventilation engineers etc.

c) Medical Doctors

Sixteen hundred (1600) units of breathing apparatus with 400 litres of oxygen reserve are maintained ready for use in F.R.G. Wireless communication between a base station and the mine rescue workers ensures rapid response to a callout. It is reported that response time is in the order of 30 minutes from call out to readiness for action. Records show that rescue teams were used 838 times over the past 20 years. This is an average of 42 callouts per year.

4.5 POLAND

A Paper on Polish Crisis Management was presented at the Crisis Management Symposium in Sydney by Dr. P.A. Krzystolik of Safety in Mines Institute - Mikolow Poland. The essence of that paper, as it relates to mine rescue practice, is summarized below. For more detail the reader is referred to the proceedings of the Symposium. (See also Appendix IV Section 4.5).

Mining Operations

The state owned Polish mining industry is described as being centred in three areas, Upper Silesia, Lower Silesia and the newly developed Lublin Coal Basin. Total coal production is approximately 200 million tons annually. The coal seams are known to be gassy, prone to spontaneous combustion and subject to rock bursting. Water problems are associated with the Lubin Basin.

Mine Rescue Planning

Polish mining law requires a plan of rescue action to be filed with the District Mining Authorities. They define difficult rescue actions as being operations conducted under conditions of high temperature (+40°C), elevated CO and CO_2 levels, water and operations that require breathing apparatus.

Mine Rescue Organization

Three levels of organization exists in Poland. The Central Mine Rescue Station in Byton provides direction to all mine rescue activity in Poland. Twelve District Mine Rescue Stations provide decentralized facilities near operating mines. The district stations are staffed and equipped to provide technical, material and manpower reserves to service rescue operations in their area. One district station maintains 56 permanent, highly skilled, professional mine rescue workers for specialized work.

In addition, mine rescue stations are organized at each mine to support the mine site teams. The minimum number of trained mine rescue workers and breathing apparatus required are as follows:

Number of Persons Employed Underground/Day	Breathing Apparatus	Rescue Workers
Less than 500	12	15
501 - 1000	18	30
1001 - 3000	24	30
More than 3000	30	30

4.6 U.S.A.

Information relating to mine rescue in the United States was gathered mostly from visits with various people. Visits with personnel of the U.S. Federal, Mine Safety and Health Administration (MSHA). Mr. John Chambers, the MSHA Mine Rescue Team Leader and Trainer, met with Mr. K. Gurr of Norwest at MSHA Pittsburgh Forbes Avenue training and Storage facilities. While at Forbes Avenue, Mr. Robert Pelusd, Chief of the Health

Technical Center provided information on equipment approval procedures, technical studies, and on the organization of the Mine Emergency Operations group (M.E.O.). A visit was made to the 60,000 sq. ft. warehouse storage facilities for the M.E.O. equipment at Aliquippa, Pennsylvania, in the company of Mr. J. Kravitz, Chairman of the Research Review Committee for M.E.O. Mr. Kravitz mentioned the availability of a 17 minute, 16 mm film about the M.E.O.

To review the preparation of the latest U.S. mine rescue training manuals Mr. Gurr met Professor R. Althouse in Morgantown W.Va. Professor Althouse is from the University of West Virginia. Mr. Gurr also met Dr. D. Elliott, Mr. Bill Moser and Mr. Thomas Savage of the University of West Viriginia Mine Extension Service. Discussions focused on Mine Rescue/Mine Emergency Regulations and practices.

Mr. J.C. Julian, of Dayton T. Brown Inc., discussed with Norwest in general terms, their work on environmental and durability testing of the "Trapped Miner Transmitter" (TMT) units. This is a research project funded by the Bureau of Mines. Printed material on this device is given in Appendix VII, Section 7.9

Norwest received considerable help and advice concerning U.S. mine rescue in western hardrock mines from Mr. M. Smith, the Mine Rescue Superintendent of the central rescue station for the metalliferous mines in the Kellogg, Idaho area.

In the United States, ensuring that mine rescue services are available for every underground mine is the responsibility of the mine operators. The method of doing this and the standards which must be observed in all mines, are given in considerable detail in the "Code of Federal Regulations (CFR)", Title 30 - Mineral Resources, Part 49. Refer to Appendix III, Section 3.5.2 for more details.

The operator can comply to the Regulations in two ways; he can establish at the mine, at least two rescue teams who are available at all times; or he can enter into an arrangement with others whereby he can ensure that at least two rescue teams are available upon request. The teams consist of five persons plus a reserve member and are trained and equipped in accordance with the Federal Mine Safety and Health Authority requirements (M.S.H.A. standards). A mine rescue station must be within 2 hours ground travel time from the mine. The operator must also provide transportation for teams and equipment. The operator's scheme for mine rescue operations must be filed with the M.S.H.A. District Manager, and a copy must be posted to inform the mine employees.

Alternative rescue arrangements can be made for small or remote mines with the M.S.H.A. District Manager's approval. The operator must post a copy of this arrangement at the mine site. The District Manager must take into consideration any comments made by employees at the mine when asssessing an operator's proposal. Special arrangements can also be made to cater for certain special mining conditions. These arrangements are granted when mining conditions much less hazardous than are encountered.

Mine rescue stations must provide a centralized location for the storage of equipment and apparatus. The equipment must be maintained and kept ready for use. The stations are subject to M.S.H.A. inspection. Item 4.9.6 to Part 49 in Appendix III, Section 3.5.2 contains a list of the equipment that has to be kept at the mine station. It usually consists of the following items:

a) 12 units of breathing apparatus plus the associated testing equipment
b) portable supplies sufficient to keep each rescue team in operation for 6 hours
c) oxygen supplies
d) gas detectors

e) portable communication system of 1000 ft. (minimum)

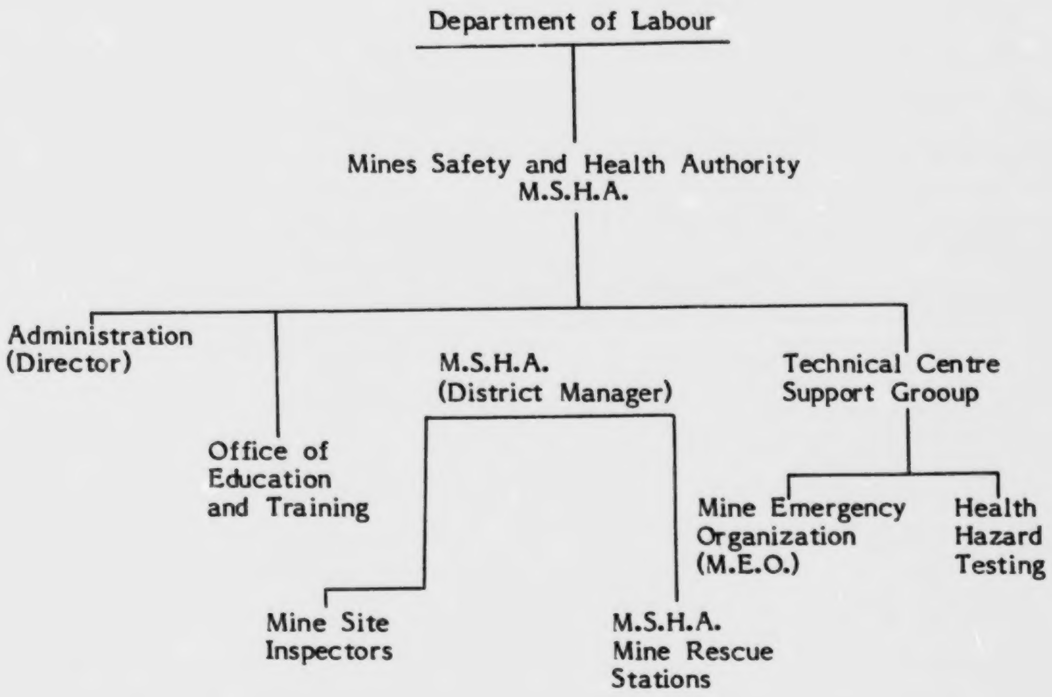
One person (usually the Rescue Station Supervisor) is trained to inspect and maintain apparatus at the station. Rescue teams are trained by an instructor with mining experience. The instructor must have been trained through an M.S.H.A. course arranged by the Chief of the Training Centre who operates within the M.S.H.A. Office of Education and Training.

In some States mine rescue services are being set up so that the mines in the State can enter into an arrangement as specified in Item 4.9.2 (Appendix III, Section 3.5.2). The arrangement is made, sometimes through a State Department of Mines or similar body, and sometimes through a group of mines setting up their own rescue station such as at Kellog, in the State of Idaho. The first example of a State run mine rescue service is in Kentucky. More details of this are provided in Appendix IV Section 4.6.

The Mine Safety and Health Authority (M.S.H.A.) organization is Federally funded. It has an administrative centre in Arlington, Virginia. The mining areas of the U.S. are divided into M.S.H.A. districts with each district having a District Manager who supervises a group of Inspection personnel. This is M.S.H.A.'s front line force for ensuring compliance with their standards of safety which include mine rescue. In addition to administration and inspection, there is an Office of Education and Training, and a Technical Support Group (Figure 4.11).

Figure 4.11

UNITED STATES


Department of Labour
Mines Safety and Health Authority
M.S.H.A.
Administration
(Director)
Office of
Education
and Training
M.S.H.A.
(District Manager)
Technical Centre
Support Grooup
Mine Site
Inspectors
M.S.H.A.
Mine Rescue
Stations
Mine Emergency
Organization
(M.E.O.)
Health
Hazard
Testing

As a back-up for incidents of major proportions and to offer support to small mines with little experience in handling rescue and recovery operations, M.S.H.A. operates a number of Rescue Stations of its own.

The M.S.H.A. officials and mine rescue teams are available to any mine that has problems. M.S.H.A. has the authority to close the mine and direct rescue operations. The minimum requirements by law for each mine rescue stations are the following items:

a) 12 Breathing apparatus plus testing equipment
b) 6 Hours oxygen supply for each team member
c) 12 Cap lamps and charges
d) 2 Oxygen detectors or flame safety lamps
e) 12 Mine Rescue Workers
An approved mine communication system, and spare parts

The team, mostly M.S.H.A. inspectors, can very quickly load everything on a van or airplane and travel to any mine disaster area. In the Pittsburgh Station, they have their own training area and smoke room in the basement of 4800 Forbes Avenue. Judges for the State and Regional Mine Rescue Contests and superintendent of the National Final Contests are chosen from these teams.

The Technical Centre support group provides health hazard testing which includes the testing of ventilation and gases, toxic substances and hazards of a physical nature. This group also works closely with the National Institute for Occupational Health Safety and Health (N.I.O.S.H.) for the approval of certain types of equipment (includes mine rescue breathing apparatus and self rescuers). Design specification, man tests and special testing can be done in the N.I.O.S.H. laboratories in Morgantown, W. Va.

A new service from this team is to provide testing and to monitor equipment. When they are called to an accident or explosion site, both teams will respond. They will set up monitoring equipment at the fresh air base or main fan and do chemical analysis of air samples on site. The M.S.H.A. rescue teams assist the local teams and provide direction and supervision.

The Mine Emergency Organization, (MEO) which also comes under the Technical Support Group, has very specialized personnel and equipment operating from the M.S.H.A. No. 1 and No. 2 Districts. Their two stations are located, one by the Greater Pittsburgh Airport and the other at the Federal Centre in Denver, Colorado. At present it takes about 2½ hrs for the crews to assemble and prepare the equipment for transportation.

MEO's function in mine disasters is to travel to the mine site and assist local officials in locating and extracting trapped miners. (Ref: MESA Information Report/1975 IR1011 - U.S. Dept. of Interior)

The partial list of their equipment:

1	1500 Drill with 28½" bits
1	2500 Drill with 28½" bits
1	Mobil supply van
2	Complete sets of drill steel, air compressors, winch trucks, etc. (trucks are rented as needed)
1	Seismic van with computer and phone
1	Television probe van for downhole viewing
1	Analytical van for testing
2	Extraction cages
2	Communication van
2	Tube bundle gas analysis systems
	D6 cats
	Sonar adaptions for television system
	Miscellaneous

Additional equipment in Denver includes communications and analysis vans but no drilling equipment.

This equipment was assembled by M.S.H.A. with the help of Westinghouse. The initial cost (1971) of equipment was probably around $2,000,000, but many items are special or custom made. It takes a crew of 10 people full time to maintain and improve this equipment. The Pittsburg equipment is all stored inside a 60,000 square foot warehouse.

The functon of MEO is to move to a disaster area. They can be mobilized by route or by C-130 or C-5 cargo planes. They have the ability to be on site in approximately 30 hours. When the team reaches the site, they set up seismic survey to try and locate trapped miners.

4.7 NEW SOUTH WALES - AUSTRALIA

An outline of the organization in N.S.W. is given in Appendix IV Section 4.7. The outline is part of a paper written by M.J. Muir, N.S.W. Chief Inspector of Mines and by J. Strang, Superintendent of the Mines Rescue Station, Bellambi, N.S.W, which was presented at the International Symposium on crisis management held in Sydney, N.S.; October, 1982.

4.8 OBSERVATIONS AND COMMENTS

Mine rescue legislation and mine rescue organizations are so interrelated that any discussion on organization is bound to make reference to the legislation. It is suggested therefore, that the following comments and recommendations be looked at, not only in connection with the information in Part 4, Sections 4.1 to 4.7, of this report but also with the comments at the end of the previous section on legislation, Part 3 of this report.

So far as organization of mine rescue is concerned, the situation in the European countries is significantly different from that of Canada. Germany, Britain and Poland are all, predominantly, coal mining countries. Their coal mines are large and usually situated in areas where there are a concentration of similar mines. Usually the mines are state owned operations and therefore mutual assistance and cooperation is more easily achieved on a national scale. In addition, these countries have a Central National Government which is the source of the Mining Industry's Safety Regulations.

The mine rescue organization provided by the U.S. Code of Regulations is more adaptable to Canada'a mining industry than those of Europe because the U.S. Federal Code caters to a mixture of coal, metalliferous and other mines which are similar to Canada's. Mines are operated by Crown Corporations in Canada closely resemble mines operated by the private sector since they are both operating within the same economic regime.

There is, however a major difference between Canada and the U.S.; in Canada, each Province is responsible for its own mining legislation whereas in the U.S., overall Federal standards are legislated nationally.

What is noticeable, is that the standards of mine rescue in Europe are very good and those in the U.S. are potentially good. Though the U.S. is still under development with the M.S.H.A. organization, it is apparently moving very quickly towards a first class, nationally integrated organization. If Canada's provinces wish to do the same, they must move towards adopting similar legislation within each Province.

It is the writers opinion that, the following features are, or should be present, in good mine rescue organizations.

a) It should be based on fairly detailed legislation which has built - in flexibility, but which is not subject to constant review.

b) The mine site rescue organization will be integrated with an overall mine emergency plan which interfaces with local services such as ambulance, hospital, police etc. Not all

Provinces specifically require this and there are none where the effectiveness of this aspect of the organization is required to be tested. Some people expressed doubts as to whether the limited medical facilities in the smaller mining communities had "burn units" which could handle more than two or three serious burn cases at one time. An ignition of methane or other flammable substance could result in the need to treat more than this number.

c) The Rescue and Emergency Plan will include the means to sustain an ongoing rescue operation for 2 full days (24 hrs/day). When teams are put into action, it is European practice to have one team working, one team at the fresh-air base with apparatus donned but not activated, and a replacement team at the surface resting but on standby. The rescue organization at most mines consists of two teams. This is usually sufficient to deal with only the immediate needs of an emergency.

d) Proposed changes to an existing Rescue and Emergency Plan must be posted and employees should have an opportunity to propose improvements. The final Emergency Plan should be approved by the appropriate government authority. The opportunity for employees to be involved in the proposals for schemes which affect their safety is increasingly evident in both Europe and the U.S. This is not usually provided for in Canadian mine rescue programs.

e) The Mine Rescue Organization should provide for the rescue and recovery operations to be managed and directed by one person, who would be designated by the mine operator. The responsibility for directing a rescue operation should not be assumed by a government official. However, suitably qualified and experienced government officials, such as Mines Inspectors and Rescue Coordinators, would be invaluable in helping and advising the management. The Rescue and Emergency Plan should recognize this.

In connection with the comments made in (e) above, it is worth reviewing the considerations on which they are based. Firstly, it is important to keep in mind that, when an emergency arises in which the services of rescue teams are needed, the situation will invariably involve making quick decisions. These decisions have to be made quickly and cannot be delayed even though all facts are not known at the time. It is therefore of immense value to have the direction of recovery operations in the hands of someone who is intimately familiar with the mine on a day to day basis. A member of the operational management of the mine is obviously the most suited from this point of view. Of course, a local Mines Inspector can be considered as being familiar with the mine in general but not "intimately familiar" on a "day-to-day basis".

A second point to keep in mine is that the lives at stake in a mine rescue are generally those of mine employees and rescue team personnel who are, company employees. The property which the rescue seeks to protect or recover usually pertains to the mine company as does, in most cases, the apparatus, equipment and costs of the operation. For these reasons it is difficult to justify placing the responsibility for directing the operation in the hands of anyone but the mine management. However, this responsibility brings with it the duty of having in place an adequate emergency organization and of having the skills and abilities to discharge the responsibility. The necessary organization can be established by legislation. It is here where mines inspectors play important parts both in advising and in setting standards. As to having the skills and abilities necessary to direct rescue and recovery operations, the issue is not so clear cut. The coal mining industries of countries such as Canada and Australia follow in general, the method established in Britain in which managers and undermanagers of coal mines are required to hold certificates of compentency. Granting of these certificates involves examinations in which the candidate must demonstrate a reasonable knowledge of mine rescue and recovery work. This not always true of all types of mining or of all jurisdictions in Canada. This particular aspect is referred to again in Section 8.3 of this report. Where there is shown to be a lack of knowledge and ability in mine rescue, some jurisdictions have deemed it necessary for the appropriate government agency to assume the management's responsibilities. An example of where this might be necessary would be where there are a large number of very small mines, each owned, and operated by individuals who lack the training, knowledge and equipment to adequately organize mine rescue operations. Most jurisdictions in Canada legislate that the responsibility to direct the rescue and recovery operations belongs to management.

The final comments concern the special role of the Government Mines Departments, specifically the roles of the Chief Inspector, Mines Inspectors and Mines Rescue Officers. The demands on a Chief Inspector, in most cases, will preclude his continued personal presence at a recovery operation. The government is usually represented on-site by the local Inspector and Mine Rescue Officer.

Rescue and recovery operations invariably incur some element of risk depending on the severity of the incident. Where there are trapped workers and/or multiple fatalities, there is also a significant level of distress and emotion involved. These factors are often complicated by the need to contain the emergency so as not to affect other parts of the mine. This means risks have to be assessed under duress and decisions made as prudently as the circumstances permit.

Under these conditions it is most important that there is someone who can devote his attention to ensuring that the director of the operation is kept fully advised of legislative requirements and has available the advice and assistance of someone who is not closely involved with either union or company. The Mine Inspector can fulfill this role very well. The government mine rescue officer will also be able to offer valuable advice on the direction of the operation.

Where incidents require rescue team services, they frequently receive considerable public and, at times, political attention. They are often the subject of an enquiry and can possibly face legal action. In these cases, the Mines Inspector has a key role in subsequent investigations and enquiries concerning the direction of the recovery operations. If government officials are given the responsibility of directing the recovery operations, they can hardly enquire into their own actions with the necessary impartiality.

4.8.1 Federal Involvement

When a serious, long term, mine emergency arises (i.e. more than, say, 48 hours) and there is a need to move teams and equipment to the site of the emergency, Federal involvement should be considered. An organization could be set up, through a Federal agency, whereby helicopters and other equipment could be made available for transporting teams, supplies and special apparatus to emergency sites. It would be particularly helpful to some of the more remote areas of the country. The arrangements made between M.S.H.A. and the U.S. Air Force illustrate the accord ("Memorandum of Understanding") that was attained in the U.S. (see following page).

APPENDIX E.--MEMORANDUM OF UNDERSTANDING BETWEEN THE MINING ENFORCEMENT AND SAFETY ADMINISTRATION, DEPARTMENT OF THE INTERIOR, AND THE DEPARTMENT OF THE AIR FORCE

April 5, 1974

Mr. Frank A. Shrontz
Assistant Secretary of the Air Force
(Installations and Logistics)
The Pentagon
Washington, D. C. 20330

Dear Mr. Shrontz:

The Memorandum of Understanding transmitted with your letter of February 28, 1974, covering Air Force airlift in support of Mining Enforcement and Safety Administration efforts to rescue men trapped by mine emergencies, has been signed and a copy is enclosed for your files.

Also enclosed is a listing of personnel authorized to request assistance under this agreement. Positions are listed with present incumbents. It is our practice always to have a man acting in each position when the incumbent is absent from his office, so that you might be contacted by an acting official whose name is not listed. We utilize a contractor to handle logistics for MESA during mine emergencies. Our present contract is with the Westinghouse Electric Corporation, Defense and Electronics Center, Baltimore, Maryland. The contractor will determine the availability of commercial air transport and, as our agent, will be authorized to contact your staff directly during an emergency. MESA will always make the initial contact with you when an emergency occurs. We would like to arrange a meeting to brief you and your staff on our procedures and probable airlift requirements.

On behalf of MESA, I want to thank you and the Air Force for your cooperation and assistance in our efforts to reduce the human costs that have been associated with mining.

Sincerely yours,

(sgd.) James M. Day

Administrator

Enclosures 2

4.8.2 Surface Mine Rescue

Not all Provinces require a Surface Mine Rescue Organization under their respective legislation. Nevertheless, some Provinces specifically require it, and others include both surface and underground in their general requirement for mine rescue service. There are other cases where it is either not required or the general requirement for mine rescue is assumed to mean only underground.

In all cases, it is usual for surface mines to have a firefighting organization. Discussions with operators and Government Mines Safety Inspection Departments suggest that the simplest and most effective way to provide rescue services is to provide additional training and equipment to upgrade firefighting crews into fire and rescue crews - sometimes referred to as a mine emergency crew.

This method of organizing does two things:

a) it avoids having both a fire crew and a rescue crew which most operators regard as unnecessary and could result in organizational confusion during an emergency

b) it utilizes manpower and equipment more efficiently.

At mines where well equipped surface rescue crews are used, a high degree of skill and speed in responding to emergency calls have been demonstrated.

Most crews train regularly on a basis similar to underground crews. Their equipment is inspected by Government inspectors. Most Companies usually have equipment which exceed the minimum requirements. In addition to firefighting (in which the use of breathing apparatus is required by training), the rescue crews are called to deal with runaway/overturned vehicles, rescues from inaccessible places such as high buildings, towers, silos, and dragline and bucket wheel booms, and rescue from dangerous fumes and vapours such as might occur in a processing plant.

The utilization of surface mine rescue depends very much on the type of mine and the mineral produced. For example, the fire hazard associated with a tar sands processing plant or a coal preparation plant is much higher than that of a hardrock mill and separator.

The apparatus used by surface emergency crews, in addition to firefighting equipment includes:

a) 30 minute pressure demand breathing apparatus (eg. Scott air paks)
b) Ropes, blocks, tackle and lifting equipment
c) Hydraulic cutting equipment for cutting open heavy vehicles
d) Semi ambulance vehicle with winch.

Because of the special skills and equipment, surface emergency crews at mines are frequently utilized by local police. This pays tribute to their willingness and ability to respond to an emergency. However, when the crew do answer a police call, they and their equipment are not available to answer an emergency at the mine site.

One surface mine emergency crew in B.C. answers more R.C.M.P. calls than mine emergencies. These calls for help have been to deal with people trapped on mountain sides, in automobile crashes, and vehicles in rivers. At one of the tar sand mines in Alberta, there are four rescue teams who work with four firefighting teams under the direction of an Emergency Coordinator. In 1982 they responded to 222 fire calls. They are often called to assist R.C.M.P. with highway accidents.

SECTION 5
MINE RESCUE WORKERS - CANDIDATE SELECTION

5.1 INTRODUCTION

There are three levels of selection for mine rescue team workers. The first is very simple, it is those persons who volunteer to undertake a basic mine rescue course. There are two main reasons why people volunteer:

a) they are interested, career miners
b) they need the training in order to be promoted to a supervisory level.

The work of mine rescue involves:

a) a high level of physical effort under a wide range of ambient conditions
b) the use of breathing apparatus which is demanding on the lungs and heavy to wear.

Because of these factors, the second level of selection used is based on age and physical condition. On selection, the candidate undertakes the basic training. It is during this stage that he can be observed and a final selection is made based on his physical and mental performance, and his behavior. He needs to be quick and responsive; able to think while under physical strain; able to read instruments; able to maintain a high level of self control with an ability to resist panic without being fool hardy. The ability of a rescue team to carry out its assignments efficiently and safely depends very much on the screening and final selection of team members.

5.2 QUALIFICATIONS

5.2.1 Age and Physical Condition

Age

In almost all Provinces, rescue team personnel must be between the ages of 21 and 45 years. In B.C. and Manitoba, the minimum age is set at 18. The maximum age is set at 40 in Nova Scotia and 50 in Manitoba. Some Provinces do not legislate on age but have a rule which is usually 21-45. The N.W.T. and Yukon will accept trained persons from any other Province and therefore, presumably, will accept any person from 18 to 50 years of age. In practice, the lower age limit is used to permit a person to take basic training, but selection for a team is based very much on relevant experience.

Medical Condition

A satisfactory physical condition is invariably determined by a medical examination of the candidate by a medical doctor. In some Provinces, the nature of the examination is left to the doctors discretion and a doctor's statement of physical fitness is all that is required. This has, at times, resulted in a most perfunctory examination. Many of the mine rescue people interviewed were of the opinion that the unfamiliarity of most doctors with the nature of mine rescue work, and the physical and emotional demands that it makes upon a person, is not conducive to satisfactory examinations. Many Provinces specify the examinations that are required. This appears to be a satisfactory method provided the examination specification and associated questionnaire is drawn up by a medical authority who is familiar with mine rescue work. For those actively engaged in rescue work, the physical examinations should be repeated at yearly intervals. Most Provinces require this.

There are some aspects of the medical examination that do not seem to have been adequately considered. Examples that have been mentioned are listed below:

a) Eyesight
   Colour blindness and the ability to discern colour codes and colour stains on gas determination tubes.
   Use of contact lenses and eye glasses. (See U.S. Fed. Code 49.7 Appendix III Section 3.5.2)

b) Hearing
   Many hardrock miners have less than 100% hearing. As radio and telephone communications replace horns for signaling, hearing is becoming more important. Good hearing is necessary for sounds of imminent roof failures and signals for help (See U.S. Feb. Code 49.7 Appendix III Section 3.5.2). Hearing aids are not permitted.

c) Loss of limbs or appendages
   Obviously loss of an arm or leg must disqualify. Manitoba will not accept the loss of a thumb or more than two fingers on one hand. No one has set a limit on toes.

Examples of doctors examination requirements are given in Appendix IV Section 5.1. See also Appendix IV, Section 4.4, Part A, Encl. 3.0, Item 2.3 and Encl. 5.

Physical Fitness

For many years the Ontario Mine Rescue Handbook was used as a guide for the assessment of physcial fitness. In recent years numerous other indices of fitness have been developed in relation to Canada's "participaction." Physical fitness is the ability to perform work, at specified rates for specified periods of time.

In 1978 the mine rescue centre in Essen, West Germany, conducted a "perseverence" or "endurance" study of 300 mine rescue team members. The study concluded that only 42% of the sample group were in good to excellent condition. Fourteen percent (14%) were shown to be in inadequate physical condition to meet the requirements of mine rescue.

As a result of these findings regular ergometric examinations are performed on the mine rescue team members and those failing the test are placed on a fitness program of rehabilitation training (See Appendix IV, Section 4.4, Parts A and B).

The NCB has established fitness standards for rescue workers to maintain. It is an employment condition. Physical training programs are scheduled and training facilities are provided to help in enabling these standards to be met.

Galleries at U.K. mine rescue stations have the facility to alter the temperature and humidity of the atmosphere in the gallery. Smoke can be introduced to replace the air in the gallery. Real underground hazardous conditions can be produced and training sessions can be conducted in a range of environments to keep rescue workers acclimatized to harsh conditions. There are no facilities of this type available for Canadian rescue workers.

The ability of a candidate to withstand emotional stress and fears without loss of effectiveness is important. This includes handling the seriously injured and burned and dealing with corpses. There must be no excessive fears of confined spaces or water. An assessment of the candidate is normally made during this training and practice session. His acceptance by the other team members is also an important factor. This final selection stage is very much a judgement made by trainers and instructors who know the candidate personally and are able to consider his lifestyle and living habits. There are no obvious shortcomings in what is presently being practiced.

The following chart is an example of one method used to assess a candidate during his basic training.

5.2.2 Certificates of Qualification and Experience

In order to have acquired sufficient knowledge and skill in mining systems, ventilation and mining equipment, and to be a useful member of a rescue team, it is suggested that a minimum of 2 years of relevant experience be required. Though this is not always stated in rules, it is generally practiced. It is during this 2 years that the candidates' mining abilities are assessed.

Certificates of qualification for a member of a rescue team are generally the same across Canada:

- Basic first aid certificate (St. John or Red Cross)
- Basic mine rescue certificate
- Attendance at mine rescue training courses

5.2.3 Supply of Candidates

There were no reports of a serious shortage of candidates for underground teams. There were areas where candidates for surface rescue teams were a little scarce and this could be because workers on open pits do not share the same mining traditions as the underground men. This is often also true of some openpit managers who, consequently, do not impart the same encouragement as do their underground counterparts.

INSTRUCTOR'S ASSESSMENT OF MINE RESCUE TRAINEE

NAME ______________________________

DATE ______________________________

PLEASE CIRCLE ONE

Interest in Mine Rescue Training —		Keen	Average	Below Average
Discipline as a Team Member —	Excellent	Good	Fair	Unsatisfactory
Alertness and Response to Instructions —	Excellent	Good	Fair	Unsatisfactory
Temperament —	High Strung	Moderate	Easy Going	Lazy
Composure while under oxygen in smoke —		Good	Fair	Unsatisfactory
Practical knowledge of Drager BG-174 —	Excellent	Good	Fair	Unsatisfactory
Practical knowledge of Mine Rescue equipment in general —	Excellent	Good	Fair	Unsatisfactory
Does he have leadership Ability?		Yes	Maybe	No
Is the applicant known to be unreliable because of the use of Alcohol or Drugs?		Yes		No
Does he have any personality traits or problems that may adversely affect his work as a member of a mine rescue team?		Yes		No

After observing this man during his Basic Mine Rescue Training, I believe that he will be a suitable member of a Mine Rescue Team.

____
Instructor or Supervisor of Mine Rescue Training

COMPANY ______________________________

At present there is little or no turnover of labour in the hardrock mines of the Yukon and N.W.T. However, it was said that there had been a minor problem at times to maintain regular teams.

Where mining activity of a region is confined to a number of small operations, it can be difficult for each mine to raise the number necessary for a team. Legislation usually makes provisions for this difficulty in Provinces where it arises. The U.S. Federal Code Section 49.3, (Appendix III, Section 3.5.2) offers an approach to dealing with this difficulty.

5.3 COMPOSITION AND SELECTION OF RESCUE TEAMS

It is standard practice in Canada to have rescue teams made up of 5 men and 1 reserve. This means that 5 men are active with one man stationed at the base ready to replace an injured team member. To be operational the team requires 6 men with 6 breathing apparatus units.

The composition of rescue teams in terms of command is simple. All orders are given by a Team Captain. There is also a Vice Captain who only issues orders in the event that the Team Captain is incapacitated. It is desirable that all persons forming rescue teams at a mine or rescue station should be named by the Mine Manager (or the Station Superintendent if the men are from different mines). This is not required in all Provinces. In addition, the Captain and Vice Captain should be designated. The list of names should be sent to the local Inspector or other suitable authority. It should be mentioned that this is already done in many Provinces.

When the manager selects the rescue team members, he should consider these two points; first, that the team members should be interchangeable; and second, that the personal skills and abilities of the individual team members should include some diversity. For example, it may be prudent to select Captains and Vice Captains from among the mine supervisors. It is these people who will be most knowledgeable of the overall layout of the mine and be experienced at giving instructions and dealing with management staff. It is not wise to commit mine management staff to rescue teams because in an emergency their talents would be more valuable elsewhere in the organization. For the rest of the team, it is always wise to include ventilation engineers, electricians, welders, carpenters, masons and mechanics as well as operators of various machines such as drills, shotcrete blowers, scooptrams and hoists.

The need for interchangeability is important. Even though the same team may normally be together, there are many reasons why the persons constituting a team may have to be varied. For example, some members may not be available because of sickness or accident and there may well be occasions when the task to be performed can best be done by a team made up of people with the necessary combination of skills.

It is normal practice in Canada for the members of the 5 man team to keep together at all times. If a team member has difficulties of any kind, it is obligatory that the whole team return to the fresh air base. Although not always specifically stated in Regulations, this is normal practice followed by most jurisdictions. Its purpose is to maintain a form of mutual safety support for team personnel who are expected to work in what are, usually, dangerous conditions.

Where conditions are well below the usual hazard level due to the nature of the work, the environment or limited exposure, some jurisdictions have allowed the use of 3 man teams. For example, N.S.W., Australia, uses a special 3 man team to install tube bundle sampling lines and to take samples. Their task is specific and their exposure limited. A rescue team is usually operating and/or on standby nearby during this time.

In Canada, only Ontario and Quebec permit a minimum 3 man team to be used. This is then only at the discretion of the rescue operation director who must show that there is a justifiable reason for their use and that the have been carefully appraised. This would most certainly include the advice of Mine Inspectors and experienced rescue personnel. The view taken by Quebec is:

> "We can allow the use of three-man teams once the risks have been carefully studied by those responsible for the rescue operations".

Ontario's advice is as follows:

a) Be assured, before undertaking rescue work, that there is a sufficient number of trained men and apparatus to complete a standby team with an equal number of rescuers as in the team at work.

b) Be assured that the distance to cover is relatively short, that the hazardous conditions are minimal and that the team is travelling in familiar territory.

c) Consider the time of the mission, the conditions of the surrounding air and the efforts which the team members must furnish.

d) Consider any other factor which could mean a greater risk for a three-man team.

The director of operations has the responsibility to decide whether it would be preferable to use a three or a five-man team.

Several mines having but six trained rescuers can at times, by forming three-man teams, save lives or extinguish a starting fire that may threaten to spread.

As mining technology and techniques develop and the application of instrumentation increases, it is possible that the use of 3 man special task teams will be added to the conventional mine rescue concept. The pros and cons of 3 man teams and Legislative changes that might be involved should perhaps even now be receiving some attention.

5.4 REMUNERATION

In Canada there are a number of ways in which rescue workers are rewarded. Remuneration is not the main reason why volunteers join mine rescue, for most, remuneration is a symbol of the company's appreciation for their efforts. By the same token, poor remuneration can soon cause interest to fade away. Fortunately, in Canada, most companies have reasonable rates of remuneration which are in keeping with their locale and customs.

Remuneration is different for each level:

a) Attending training sessions
b) Active
c) On-call

To illustrate the differences across the country it seems best to present examples of what was found during the survey.

Attending Training Sessions (Rescue team members)

Newfoundland: Varies between normal rate of pay and $10/hour for 4 hour session.

New Brunswick: An annual bonus of between $350 to $500 is paid (ie. $8.75-$12.50/hour).

Nova Scotia: Varies between $57 and $81 per 4 hour session (ie. from $14.25-$20.25/hour).

Ontario: A mine rescue bonus is paid to each team member in amounts set at the discretion of the management. It varies from a "per diem" for each working day (plus the regular rate and incentive bonus that would have been earned on the training day) to a double daily rate plus the incentive that would have been earned on the training day.

Manitoba: Varies between $15 per month extra to normal pay; and 50¢/hour added to the daily rate of any team member who has an Advanced Mine Rescue Certificate.

Quebec: Each team member receives one extra day pay for every scheduled training day. In the event that the training session is not attended, due to sickness and vacations, etc., he still receives his training pay.

Saskatchewan: It is usual for practices to be on company time and therefore the payment is at the man's usual rate. If practices are extra to normal working hours a man is paid at 1½ x his usual rate.

Alberta: A Team member attends 10 practices per year, on week ends, at his own time. For this he receives his regular rate plus a $90 honorarium per practice.

B.C.: Varies widely; training done in company time usually paid at normal rates with some payment made as a bonus or extra if training is outside of company time. There are some cases where all training is voluntary and nothing is paid. The two following case examples illustrate in a little more detail.

Example A: A Coal Operation

The minimum rate paid for all rescue practices is a journeyman's rate (the top hourly rate). Anyone with a rate higher than this gets his own rate. Practices are on company time.

Example B: A HardRock Operation
All training is on company time and paid at regular basic rates (contractors lose their bonus for that day).

In all areas across Canada, it is not customary to pay for a person taking his basic mine rescue course. Remuneration is only normally offered to persons assigned to the mine's rescue teams.

Active and On-Call

Rescue team members may assist at an emergency in three different stages:

a) he may be at home, but ready to be called out at any time
b) he may be onsite, surface or underground, as part of the standby team while another team is working
c) he may be working on the emergency using his breathing apparatus, ie. "under oxygen."

The remuneration for these categories of rescue work varies from place to place. Examples are given below:

Newfoundland: No special rates of remuneration were noted. It is possible that teams will be paid for training, but will receive a bonus at management's discretion depending on the severity of the emergency.

New Brunswick: Payment for mine site standby is at 1½ x regular rate. When under oxygen, payment is at 2 x regular rate.

Nova Scotia: CBDC pays $84.39/shift for mine site standby, and $88.10/shift when active.

Ontario: General pattern is to pay at 1½ x regular daily rate for mine site standby and 3 x regular daily rate for time under oxygen.

Quebec: 2 x regular rate per hour is paid for fresh-air base standby and when under oxygen. Straight hourly rate applies when on standby reserve. A few mines do not pay these rates and consequently are having difficulty in recruiting men for rescue teams. It is anticipated that they will eventually conform to the usual Provincial norms.

Manitoba: Callout pay or mine site standby pay is at 1½ x regular hourly rate with a minimum payment of 4 hours. For time under oxygen, rate is 2½ x regular hourly rate.

Saskatchewan: In Saskatchewan, to be on mine site standby or under oxygen (which is also the same at the training rate), the rate is 1½ x the regular rate.

Alberta: For mine site standby duty the normal hourly rates are paid and when under oxygen, $25.00/hour is paid in addition to the regular rate.

B.C.: Coal Mine, Example 'A'
When on operational service, mine site standby or under oxygen, pay is at normal working rate. The rates also apply to the team if they are called out of the area or out of the Province, although, in the latter case, the mine receiving assistance will usually pay a bonus to the visiting team.

HardRock Mine, Example 'B'
When on operational service, mine site standby or under oxygen, pay is at normal working rate.

It is common for companies to pay the wages and expenses of teams attending Provincial and National competitions. The B.C. government also contributes towards the cost of a team competing in Mine Rescue Competitions.

Competitions of any type, though they may have awards, prizes and trophies, do not give cash prizes. Some companies encourage their teams with annual banquets and by providing jackets, crests, blazers, etc.

The remuneration system used by the hardrock mines in the Coeur D' Alene area of Idaho provides one example from the U.S.

Rescue Practices on company time are paid at the man's normal rate or at his contract average. When practices are on the man's own time, he receives a bonus at the end of the year of about $100 for about 40 hours/year practice time. There is usually an annual banquet and awards night at the company's expense.

When emergencies arise, payments are made according to the following system:

a) A "helmet rate" is established annually by the mining companies of the area. This is a standard mine rescue rate, re-evaluated annually. It is equal to the average hourly wage rate for all the companies plus 25%.

b) When a rescue man is confined to his home for being on-call because of an emergency, he is paid a minimum of 1 x helmet rate and a maximum of 4 x helmet rate.

c) When on standby at the mine site or actively engaged or working under oxygen, there is one single rate of 8 x helmet rate.

These rates are considerably higher than any paid in Canada but are probably much higher than most rates commonly paid in the U.S.

5.5 COMMENTS AND RECOMMENDATIONS

The qualifications for membership in a rescue team in the various Provinces and Territories are nearly identical, and to attain uniformity across Canada would seem to be a realistic goal. A small, independent, (say two man) group, possibly financed through CANMET or Labour Canada, could be given a limited period (of about six months) in which to arrive at a Rescue Worker Selection format acceptable to all Provinces. There would be no previous commitment required from any Province to implement the recommendations of the group. The objective would be, simply, to arrive at an agreed interprovincial standard for candidate selection.

It is suggested that the following items should be addressed:

a) minimum and maximum ages
b) specifications for medical examination
c) specification for fitness tests
d) method of evaluating emotional stability and self control
e) minimum experience necessary
f) the number of people to constitute a team, with captain and vice captain.
g) certification required. This would no doubt include a first aid certificate, such as the St. John's or Red Cross. The possession of a Provincial, Basic Mine Rescue Certificate would obviously be required. It is not suggested that this group concern itself with the preparation of a Standard Basic Mine Rescue Training Manual. However, should such a manual be prepared, these qualifications for team membership would form part of it.

Once the standards have been established, they would be published along with any other guidelines which might be considered valuable. There would be no desire to impose these standards on any Province or for of any Province to accept them. It is reasoned that if the logic of the group is sound and given that the expressed desire of the Chief Inspectors is to achieve some standardization, then the value of the recommendations as a National Standard would be self evident. It would then be up to the individual Provinces to begin to move their legislation towards these standards.

So far as remuneration is concerned, it must be left in the hands of the operators. The following thoughts are offered for consideration:

a) Training on company time should be paid at a rescue training rate which would be the same for all, (possibly the highest hourly rate currently paid at the mine in question). However, contract workers should also receive the average bonus for that day.

b) Training on a man's own time should be paid at 1 x an agreed rescue training rate with no average bonus paid.

c) There seems to be no necessity to pay for a person simply remaining at home oncall.

d) 1½ x mine rescue rate seems reasonable for mine site standby whether at surface or at freshair base.

e) 2 x mine rescue rate appears to be reasonable when working under oxygen.

These values are exceeded in some areas but are given as a guide to operators starting new developments in a new area and as a reference for operators who may wish to re-evaluate their mine rescue team payments.

SECTION 6
EMERGENCY AND RESCUE TRAINING

6.1 EMERGENCY TRAINING FOR NEW WORKERS

Saving lives, preventing injuries and arresting the escalation of an incident to prevent it from reaching disasterous proportions is the objective of all safety schemes. The often dangerous work of mine rescue teams only begins when the incident has escalated beyond the control of the workers and staff at the incident site.

This indicates the importance of training the ordinary mineworker on his first day of employment, and then keeping this training fresh in his mind. He should be taught to recognize the signs of danger, to sound the alarm and notify others, and to take immediate steps to contain the danger. He should know the emergency procedures of the mine and how to safeguard himself. In Canada, this type of instruction for the newly employed is often referred to as "survival training". Unfortunately this term seems to overlook the part the employee can play in arresting or even removing the danger and seems to concentrate on his survival when the situation is already out of hand.

6.1.1 Outside of Canada

Most European and U.S. mines require the underground miner to carry a "self rescuer" and new workers are trained to use it. This is sometimes not part of a comprehensive course but a mere 10 minute formality. The same is true of many Canadian mines. Germany, Poland and U.K. all have worker induction programs which orientate the new worker to his environment and some of its dangers. In most cases the ingress and egress from the mine is discussed but sometimes this is merely a reference to a plan posted at the mine entrance. In the U.K., only a sketch plan is required, not necessarily to scale. So far as recognizing danger is concerned, the U.K. Regulations, Part III Reg. 11 (Appendix III Section 3.5.1) refers to smoke as an indication of fire and the actions to be taken by persons in charge. It has little to say about the actions which can or should be taken by individual workers.

The U.S. Federal Code is much more specific about the training of both new workers and of experienced miners returning to the industry, as well as the use of refresher courses. The Code is quite specific about some areas and addresses some important aspects (Appendix III Section 3.5.2). In connection with emergency training, the following are mentioned in the Code:

a) Self rescue and respiratory devices
b) Check in and check out systems
c) Communications systems, warning signals and escape route directional signs
d) Mine layout and mining system
e) Mine map, escapeways and ventilation
f) Emergency evacuation and protective barricading, and
g) Hazard recognition and mine gases

6.1.2 In Canadian Mines

In every Province there is some degree of new worker training, either as required by legislation or as a result of company policy. It may include all or some of the following:

a) Fire fighting procedures
b) Warning signals
c) Use of self rescuers - mandatory only in coal mines
d) Survival and refuge stations
e) Means of egress and escape route signs

In Atlantic Canada, new worker survival training is not required specifically by legislation but it is normally practised in all three mining Provinces. In Newfoundland, course material is assembled and distributed to all operating mines by the Mine Rescue Training Officer. This forms a part of the mining industry educational program designed to make management more aware of mining hazards and the methods to deal with them.

In Nova Scotia, a certificate is required by coal mine workers. As part of the certification process, the candidate is examined on matters relating to survival training. It is the practice of the Provincial Inspectorate to encourage mine management to pay attention to survival training for their employees.

In New Brunswick, mine management is required to prepare plans for emergency procedures. Survival training is not specifically called for.

The Central Provinces of Ontario, Quebec and Manitoba, where mining is predominantly hardrock fire hazard is the main concern. Quebec requires all persons responsible for fire procedures will be well informed of their duties. These Provinces usually regard survival training to be fire drill emergency procedures. These are the minimum legislated requirements. This does not prevent individual companies from using a worker's survival course.

Saskatchewan, Alberta and B.C. all provide for safety orientation or survival training in their Legislation. Canada's main areas of weakness appear to be as noted below, though this is not true in all companies.

a) Fire fighting exercises are mostly evacuation drills. Introductory training does not usually teach the basics of using a fire extinguisher and hoses. Annual drills seem to be too infrequent.

b) Little is said about ingress and egress routes. (It is recommended that there be a national, mine escape route sign, of reflective material).

c) More attention should be given to recognizing signs of impending danger as well as the immediate actions to be taken. This should include reporting to supervisors.

d) Little reference is made to Manager's emergency schemes or plans. The survival training requirements are not detailed; worker and supervisor training should be integrated with an overall plan.

For the most part, legislation appears to be in place but it is brief and unspecific. There seems to be an absence of guidelines or principles to be followed when preparing an overall emergency plan into which worker and supervisor training fits. No Province requires worker refresher courses for emergency procedures. Posting of emergency rules in lunchrooms etc. seems to be considered adequate. In one of the Central Provinces, it was reported that a survival training course had been prepared by the Government and made available to the worker on request. It is not known how the worker might learn of its existence.

6.2 TRAINING OF SUPERVISORS

When a condition of emergency or danger presents itself at the jobsite, the front line supervisor is, as a rule, the first person to be notified. His reactions and immediate instructions will determine, possibly more than any other actions, how the emergency will be dealt with from that moment on. The supervisor should be prepared to guide the workers from his section to safety and/or direct them in taking remedial or protective measures. In order for workers to develop confidence in their supervisors:

a) the supervisors must have the knowledge and training to handle emergencies

b) emergency procedures and practices in the working places of the mine should be developed around the supervisor as the key figure.

Most supervisors have been trained to make safety inspections so their movements in and around the mine mean that they, more than most workers, will know escape routes and places where safety may be sought; their work has accustomed them to giving instructions. Above all, they are usually production oriented and have received little formal training in the handling of emergencies.

In most Provinces, legislation recognizes the importance of good supervision in promoting the safety of workmen. In some cases, (particularly in coal mining) examination and certification of supervisors is required. This includes a basic mine rescue course. It is suggested that, instead of (or even in addition to) the basic mine rescue course, the supervisor should be required to undergo, at yearly intervals, a "Supervisor's Emergency Action Course". Many Provincial Mine Safety departments recognize the value of this, but at this time, no specific requirements are laid down in Legislation or Rules.

It is recommended that a Supervisor's Emergency Action Course should include the following topics:

a) The overall emergency plan for the mine.

b) The mine layout, its ventilation system, and escape routes and the location of all openings to the surface.

c) The warning systems used to warn miners of danger and begin the evacuation of the mine.

d) When and how to initiate the warning systems and the emergency plan for the mine.

e) Detection of fires and how to combat them. This should include use of fire doors and ignitions of firedamp or other gases.

f) Use of self-rescuers or other breathing apparatus that might be available; includes compressed air and Refuge Chambers.

g) When, where and how to construct protective barriers.

h) Locator signals or codes to be used by trapped miners.

i) Group survival:
   air
   water
   food
   energy
   light
   sanitation
   morale

Past emergencies have shown that a group will find its own ways of maintaining morale. However there are some aspects for which practical guidelines might be developed. For example, how to minimize the development of stress and dispondency which could induce irrational and dangerous behavior in individual members of a group.

6.3 TRAINING OF RESCUE PERSONNEL

Training methods and training courses for mine rescue teams in Canada have followed an instructor's "lecture plus practice" format for many years. The effectiveness with which the teams have approached their tasks when an emergency has arisen suggests that this training format is basically sound. In terms of training courses and schedules; the training of instructors and the development of instructional aids; one might say that there are almost as many systems as there are Provinces. Before examining the Canadian situation further, it is useful to look briefly at what is happening in Europe and the U.S.A.

6.3.1 In Europe (U.K. and F.D.R.)

The N.C.B.'s training methods are designed to meet the "Coal and Other Mines (Fire and Rescue) Regulations", 1956. Details of these Regulations can be found at the end of Appendix III, Section 3.5.1. Descriptions and details of British and German training methods are given in Appendix IV, Section 4.3, and in Appendix VI, Section 6.3.1 (Gt. Britain); and Appendix IV, Section 4.4, Parts A and B (West Germany).

The significant differences between Great Britain or Germany when compared to Canadian Practices, are in the following areas:

a) The use of permanent, full-time, rescue teams organized in a manner similar to city fire department stations.
b) The importance placed on medical examinations and the monitoring and maintenance of physical fitness.
c) The value placed on training in hot and humid atmospheres.

Coal mines of Europe include many that are deep, hot and humid. It is not unusual to have mines where the normal working conditions at the faces will have temperatures from 25°C to as high as 35°C and humidities in the 80% to 90% range. In Germany there special limits applied to the personnel who work in unfavourable conditions. These limits are given in terms of age, health, and exposure. (See Appendix IV, Section 4.4, Part A, Encl. 3, 6.6.2).

6.3.2 In U.S.A.

Training requirements for mine rescue teams are outlined in the Federal Code Part 49.8 (See Appendix III Section 3.5.2). Training course content is prescribed by M.S.H.A. Basic, or initial training is a 20 hour course on breathing apparatus. This is sufficient for membership into a rescue team. However, team members must then continue with refresher courses of 4 hours/month. The refresher course includes underground sessions and advanced mine rescue training. Course Instructors must have at least 1 year underground experience and be MSHA approved. Approval is given based on attendance at an MSHA or State Instructor's course or on qualifications and teaching experience. In certain cases underground experience may not be required for the instructor. The U.S. authorities are not yet completely satisfied with the standards of instruction being attained and a process has begun to upgrade the training facilities to satisfactory levels. The wording of the Code allows a course to be taught by a number of instructors, each of whom may be specialized in particular aspects. So far as course material is concerned, MSHA has approved for Part 49, a series of instruction manuals recently designed and written by the West Virginia University Mining Extension Service. The complete course includes:

a) An initial training module
b) Advanced/refresher modules (one for coal, one for hardrock)
c) A slide/tape program, as an option.

The preparation of these courses was under the coordination of Bill Moser and funded by the U.S. Bureau of Mines (See Appendix VI Section 6.3.2 for more details).

The U.S. training requirements do not specifically include first aid and firefighting, but both are acknowledged as being important and desirable. Up to now, there has been no legislative developments which require mines to have overall Emergency Procedures or to have Supervisors trained in emergency procedures.

6.3.3 In Canada

Mine rescue training in Canada is based on training manuals. The government department responsible for mine rescue in each Province designates the manual or training material that will be used in that Province. Ontario was the first to prepare and publish a mine rescue training handbook. This book is comprehensive and was used by many other provinces as their standard, mine rescue, training manual. Although this manual proved adequate for most types of mining, it was directed towards Ontario's hardrock mining conditions and Ontario's Mine Rescue Regulations.

At a Provincial Chief Inspectors meeting in 1980, it was decided to conduct a survey to identify the type of mine rescue training and the rescue procedures favoured by each Province and Territory. Their objective was to arrive at mutually acceptable standards and procedures for the national mine rescue competition. It was realized that this necessitated a standard Canadian mine rescue training manual acceptable to all the Provinces and Territories. A Canadian Mine Rescue Ad. Hoc. Committee was formed of representatives of each of the Provinces and Territories.

The survey was undertaken by Mr. G. Greer, Chief of Inspector of New Brunswick's Occupational Health and Safety Department and conducted by Mr. S.M. Cowan, at that time, mine rescue officer of the department. A comprehensive questionaire was circulated to the appropriate government departments seeking their comments on a wide range of topics relating to mine rescue. The results of the questionaire were summarized in preparation for an Ad. Hoc. Committee Meeting in June of 1981.

At the end of June meeting it was agreed that a very basic standard training manual should be prepared as a first step. Supplementary additions could then be prepared as needs became clearer. The tasks of preparing draft sections dealing with specific topics were voluntarily undertaken by a number of the committee members, with Mr. Cowan of New Brunswick acting as a coordinator.

Two years have now passed, and to-date only one section (on mine gases) has been submitted in draft form. During discussions with representatives of the government departments concerned with mine rescue, no-one was anticipating the completion of a Standard Canadian Training Manual. Mr. Cowan acknowledged that the work of preparing a Canadian Mine Rescue Manual had been abandoned. Some provinces have published their own manuals, dealing with survival training for new entrants, underground mine rescue and surface mine rescue. Other provinces have very little material prepared and are adopting the Ontario or B.C. Manuals with a few modifications. In some cases, attempts are being made to set up training programs using material selected from a number of publications. The current status of provincial training is outlined below.

Newfoundland Requires 72 hours/year training. It has Provincial manuals entitled:

- Basic Course in Mine Rescue
  (Very simple and basic course)
- Underground Mine Rescue Program - Standards and related procedures
- Survival for the Underground Worker
  (Based on the B.C. Manual)
- Management Course in Mine Rescue

Nova Scotia Uses the Ontario Mine Rescue Handbook supplemented by notes on coal mine conditions. Training consists of 96 hours/year.

New Brunswick Has "Mine Rescue Basic and Review Notes" and some "Prepared notes on Mine Gases". These have been developed by the Mine Rescue Officer of the Department of Natural Resouces. Training duration is 64 hours/year.

Ontario Uses its own Provincial manual, the "Mine Rescue and Recovery Training Handbook". The latest revision of this book was 1982. It is very complete, dealing with:

- breathing apparatus (all the types used in Ontario)
- auxiliary equipment
- team training procedures
- rescue and recovery course
    - advanced
    - supervisory
    - management

Five training programs are followed in Ontario:

a) 3-Day Basic An introduction to mine rescue; instruction in sources of mine gases, their recognition, detection and methods of protection against them; instruction in the principles of the operation and the testing and wearing of all types of breathing apparatus under various conditions, and the use of mine rescue telephones. A practical test and a written examination completes the basic course.

b) 3-Day Standard A review and continuation of the basic course emphasizing practical applications; practicing standard procedures, drills and strenuous exercises; simulating actual emergency conditions; and team discipline. Whenever possible, some of this is done in dense smoke and irrespirable atmospheres, preferably underground.

A practical test and a written examination complete the standard course. A Basic Certificate with Standard Seal attached is issued to the successful candidate who is now able to participate as an active team member.

c) Advanced Course This is an extension of standard training. It consists of a 2-year period during which regular, bi-monthly, 8-hour rehearsals are held. Attendance at a minimum of 10 training sessions is required. Simulated mine fire problems are practiced, mostly underground. This includes fire hose applications, man-rescue from slopes or vehicles, extinguishing fire with water, foam or fire extinguishers. First Aid is an important feature of training; particular attention is given to artifical respiration, control of haemorrhage and treatment of shock.

The course culminates in a written examination. Successful candidates receive a gold seal to be attached to their Certificate.

d) Supervisory Course The value of mine rescue training is often acknowledged by the selection and promotion of mine rescue team members to supervisory positions within the Company.

Supervisory mine rescue training requires the person to have completed the Basic, and a modified Standard Course. A 2-day course is then available, outlining emergency organization, limitations of teams and equipment, causes and control of underground fires, direction of teams and recovery procedures. Following a successful written exam, the supervisor is awarded a Gold Supervisory Seal to be added to his Basic Certificate.

e) Management Course This is a supplementary course for senior mine management. It does not require the participant to hold any of the regular mine rescue certificates. The purpose is to discuss the economics, aims and objectives of mine rescue; recent experience with mine fires and mine rescue actions. It also deals with management's responsibilities and concerns in the event of a mine emergency.

Ontario Instructors follow the "Mine Rescue Handbook" diligently.

Regular training periods for a mine rescue team consist of one full day per man, every two months, with a minimum of 40 hours/year.

Quebec Uses a french language training manual patterned on the Ontario Handbook. Basic, Regular (or standard), Supervisory and Refresher courses are provided. Training frequency is one 8 hour day every two months. The day consists of 4 hours of lectures and 4 hours underground practice. After one year as a team member, a special "Advanced" one day intensive course is taken.

Manitoba The Ontario Handbook is used in conjunction with a training schedule developed by the Manitoba Mine Rescue Officer. Training sessions are for one full day at intervals of not more than 3 months to provide a minimum training time of 40 hours/year.

Saskatchewan Has a training manual, "General Mine Rescue for Saskatchewan Mines" prepared by the Mine Safety Division. A training syllabus has been drawn up for each of the following:

a) Basic Mine Rescue and Recovery operation, 32 hours duration
b) Advanced Mine Rescue and Recovery operations, 40 hours duration
c) Supervisory Duties in an Emergency (no time fixed)
d) Company's Fire and Emergency Organization and Rescue Procedure (no time fixed)

Alberta Training Manuals have been developed for "Survival Training" and "Surface Mine Rescue" which are available through Occupational Health and Safety. Basic Mine Rescue training utilizes existing manuals from other jurisdictions, such as B.C., Ontario, Saskatchewan and the U.S. An Underground Survival Course is required for all new underground employees to provide hazard training, basic fire fighting, self rescuer use, and emergency procedures. In surface mines, new employees learn of the company's emergency organization during their Company orientation course.

British Columbia Has a comprehensive set of training manuals prepared by the Inspection and Engineering Branch:

a) Survival - Mine Rescue, no course duration stated but normally 8 hours
b) General Underground Mine Rescue Manual, no course duration stated in manual but typically 28 hours
c) Surface Mine Rescue Manual, no course duration stated in manual but typically 28 hours
d) Safety and Basic Rescue course for Gravel Pits. This is an 8 hour course.

Yukon and N.W.T. Each Territory uses the Ontario Handbook but with some minor ammendments in the way of adaptations to meet their own needs and circumstances.

6.4 TRAINING RESCUE INSTRUCTORS

The Rescue Instructor is a key figure in the whole rescue organization. His work usually includes all of the following duties:

a) Scheduling training programs, planning and organizing lectures and practice sessions, and actually teaching and demonstrating equipment

b) Preparing examination and tests

c) Examining, testing and maintaining breathing apparatus and rescue equipment, including ordering and storage of parts

d) Preparing reports and expense budgets

e) Advising management on selection of teams and other matters related to mine rescue and safety

f) Keeping up to date with new equipment developments and their application

g) Being prepared to play an important role in the emergency organization if one should arise. This will usually be the onsite organization of teams actively employed to deal with the situation.

Two examples of the duties and responsibilities of an instructor are given overleaf. These are extracts from two advertisements for positions within the Provincial Government departments.

As previous sections of this report have shown, there are either mine rescue instructors who are company employees or there are government rescue instructors. The function of the mine instructors is more or less uniform across Canada. He is to train the mine rescue teams. Government rescue instructors are also used to train teams but they are also used at times to train the instructors at the mines. The role assumed by the rescue instructor does not vary greatly whether he is a company or a government employee. His background is invariably from industry where he has gained practical experience and been an active mine rescue worker. Although he has a key role in training, he has usually had little or no special training in adult instruction or in the use of instructional aids and didactic methods. Training of Instructors in Canada is limited to attending courses or seminars hosted by other jurisdictions, and in particular, the courses provided by equipment manufacturers relating to the care and maintenance of their products. As was noted earlier, the U.S. has made a start in providing approved courses for rescue instructors.

DUTIES OF MINE RESCUE INSTRUCTOR

EXAMPLE 'A'

2. PURPOSE OF POSITION (WHY DOES THIS POSITION EXIST? STATE GOALS OBJECTIVES ETC.)

To train mining staff in mine rescue methods and fire fighting procedures by arranging and conducting training classes, lecturing and demonstrating methods of mine rescue, use of breathing apparatus and fire fighting equipment, etc. To maintain all mine rescue and safety equipment in peak efficiency.

3. SUMMARY OF DUTIES AND RESPONSIBILITIES (INDICATE PERCENTAGE OF TIME SPENT ON EACH SIGNIFICANT FUNCTION. INDICATE SCOPE, EQUIPMENT, WORKING CONDITIONS UNUSUAL FEATURES ETC.)

1. Organizes and conducts mine rescue and underground fire fighting classes by performing tasks such as:
   - planning and organizing mine rescue training classes on a regular basis for miners within a specific area (such classes accomodating 8 to 12 persons);
   - preparing lectures and notes on subjects to be discussed;
   - lecturing and demonstrating on mine rescue procedures (demonstrations of equipment use, etc., normally take place in the mine), discussing hazards to be alert for, such as gas, etc., use of breathing apparatus, methods of fire control;
   - preparing written and practical tests on mine rescue procedures, marking test papers, etc
   - studying new methods of mine rescue, testing new equipment, etc.;
   - organizing mine rescue competitions for mine rescue teams within the specific area, preparing winning team for entry in Province-wide competition.
2. Ensures proper and effective maintenance of all mine rescue equipment by performing tasks such as:
   - inspecting frequently and testing for effective operation of equipment such as oxygen and air-breathing apparatus, gas masks, resuscitators, gas detection and analysis equipment, oxygen pumps, high pressure compressors (3000 P.S.I.) and fire extinguishers, etc.;
   - performing minor repairs to equipment such as replacing defective parts, minor overhauls, cleaning, etc.;
   - maintaining stock of spare parts frequently required for equipment in order to ensure availability of equipment in emergencies.
3. Performs a variety of related duties such as:
   - preparing reports on mine rescue activities such as monthly training report, condition of equipment, expenditures, reports of fire calls, etc.;
   - maintaining mine rescue station buildings and grounds as to appearance, etc., hiring additional seasonal help as necessary for this purpose;
   - lecturing, as requested, to student groups in high schools and to groups or service clubs, etc.
   - assisting municipal fire and police departments or other government departments in emergencies, loaning equipment, servicing or repairing equipment or supplying advice.
4. Performs other duties as assigned.

4. SKILLS AND KNOWLEDGE REQUIRED TO PERFORM THE WORK (STATE EDUCATION, TRAINING, EXPERIENCE ETC.)

Extensive knowledge of underground mining, supervisory ability and thorough knowledge of operation of mine rescue equipment. Ability to lecture and demonstrate to groups.

EXAMPLE 'B'

DUTIES: The incumbent is responsible for co-ordinating mine rescue activities throughout the province and promoting the development of mine rescue teams by assisting with the organization and training of personnel. This person will prepare and deliver lectures as required, conduct examinations, make recommendations, prepare reports on mine rescue activities, training and equipment and conduct such other duties as required.

QUALIFICATIONS: Minimum Junior Matriculation, at least three years of underground mining experience and a thorough knowledge of the operation of mine rescue equipment and procedures, and the ability to lecture and demonstrate to groups. Applicants must be in good health and physical condition and be willing to travel.

6.5 ROLE OF MINE RESCUE COMPETITIONS

6.5.1 The Value of the Competitions

The importance of mine rescue competitions cannot be overemphasized. This was the view, given by both industry and governments across Canada. To list the reasons for the value and importance of the competitions would be to simply repeat what everyone concerned with mine rescue already knows. Nevertheless it is worth while to mention the following points:

a) Competing in the district, provincial and national mine rescue competitions is the single, most powerful, motivation for teams who devote their time and efforts to training

b) Competition keeps rescue skills and performance at a high level of competence.

c) Competing teams develop confidence in each other. They become familiar with different approaches to problem solving. Cooperation between teams of different mine is improved.

d) There is an exchange of ideas and operating techniques.

6.5.2 The Mode of the Competitions

The Mines Rescue Competitions are conducted in accordance with procedures and rules set out by the Chief Inspectors of the competing Provinces. During the last three years, efforts have been made to increase the number of Provinces competing in the Nationals, but have been met limited success. Some of the main obstacles in organizing a National Competition can be listed as follows:

a) The lack of a national standard training program on which competition judging can be based. This fact was recognized by the Chief Inspectors when they attempted to assemble a Canadian Training Manual.

b) Some Provinces are reluctant to make revisions to their existing practices for the sake of uniformity. They believe that current practices, developed from past experiences in their Province, should not be changed for the sake of competition.

c) Although almost all Provinces support District and Provincial Competitions, there are strong reservations regarding the value of holding a National Competition. Not all Provinces participate in the National and not all mines participate in the Provincial or District Competitions. In Ontario the cost for a team to compete at National level would have to be paid for by the mining industry. They do not feel that the prestige of entering the Canadian Competition justifies the cost of a week's training, travelling, and expenses. Manitoba has little interest in a Canadian Competition. In Quebec the C.S.S.T. has shown little interest in mine rescue competitions. There has been no Provincial Competition in Quebec since 1980 and none in planned for 1983. In some of the Atlantic Provinces, where there are only a few mines operating, the cost of sending teams to a National Competition would be high and the Province could be left understaffed for the duration of the Competition. The same is true for many of the small remote mines in several Provinces and Territories. The management of the mines of Ontario, Manitoba and Quebec, with few exceptions, fully and actively support local, District and Provincial Competitions but have very little interest in sending teams to a Canadian Competition.

6.5.3 Comments on Competitions

It was the common view of all those concerned with Mine Rescue and who gave their opinion during this survey, that the competitions should attempt to be as realistic as possible and should reflect the demands which a real emergency would put on a team. The following opinions were expressed by several rescue workers during this survey. Their comments do not necessarily express views that are shared by all but they do show some of the concerns regarding competitions.

a) Competition "problems" it was said, should be representative of "real" mine situations and that teams should be assessed according to their realistic approach to the problem. The use of a preconceived "solution" as a basis on which to assess team performance was not favoured by some. The use of "trick questions" in designing the mine problem was considered to be unsuitable and unethical.

b) Quality of work was said to be more important than quantity and that running, which is not realistically possible, should not be tolerated. A methodical and practical approach with a safe return to base within the allotted time was thought to be more important than completion of the problem.

c) Some concern was expressed that intensive training and drilling to meet unrealistic competition expectations might induce teams to make unsuitable decisions in a real emergency.

d) At the Provincial Competitions, particularly where the same small number of teams are competing each year, there is a belief that, on occasion, provincial judges will ensure that all teams have their turn as "the winners". The opinion of one rescue team was that they would rather lose than have an undeserved "win".

There is a growing realization that the competitions provide an opportunity for management to gain some experience in the direction of mine rescue operations. Mining companies should be encouraged to use mine superintendents or similar mine officials as their team's Briefing Officer in the competitions. Many companies already do this. Their interest and participation is invariabily reflected in the calibre and enthusiasm of their teams.

6.6 OBSERVATIONS AND RECOMMENDATIONS

6.6.1 Worker and Supervisor Training

a) Emergency Training for new workers and Supervisor Emergency Action courses should be mandatory. This survival training should be compatible with the overall emergency plan for the mine.

b) Workers should be better acquainted with firefighting equipment. Because fires are the most common cause of serious incidents and loss of life, prompt corrective action should be taught in addition to escape, survival, and evacuation procedures.

c) Ingress and egress routes should be clearly marked with highly visible, standardized reflective signs.

d) The term "emergency training" seems to be a more fitting description than survival training. Emergency training should be provided (and usually is) for all new mine employees - surface and underground. Refresher courses are recommended but it is not expected that this should necessitate training away from the work place. Rather it should be given by the Supervisor according to a "Refresher Schedule" which covers each of the topics of the "emergency course", taking not more than 20 minutes per shift over a period of, say, 2 weeks.

e) An investigation should be made to develop tactics and guidelines for group survival of trapped miners. The sources of information should include:

- experience of miners who have been trapped

- medical advice
- experience or studies conducted by the military

6.6.2 Mine Rescue Team Training

Health and Fitness

The great emphasis placed on medical examination, physical fitness and acclimatization to hot and humid climates, that is found in Europe, is not considered as significant in Canada.

The experience in Germany seems to indicate that one cannot assume that the nature of the miner's work will ensure physical fitness. This gives rise to the question of how fit does a man need to be? Up to now there have been no obvious signs that Canadian rescue workers are not medically and physically adequate for the job although the death of a rescue worker in Springhill N.S. was attributed to heart failure. It is ironic that rescue teams of a foreign country have used a Canadian Airforce Physical Fitness Program when Canadian teams have not. A detailed survey by CANMET could help to determine the following facts:

a) The actual level of physical fitness of a representative sample of Canadian rescue workers.
b) The minimum fitness level that should be established in terms of health, physical strength and stamina.
c) The programs of exercise needed - if any - for rescue personnel to attain and maintain the required standard of physical fitness.

It should be remembered that the rescue workers are volunteers and that any fitness program should not be that difficult or boring so as to drive away the volunteers. Fitness programs should not be made compulsory if it can be shown that they are not necessary. The views and cooperation of the rescue workers are vital to the success of the survey and subsequent programs.

Acclimatization

Mines in Canada rarely have ambient temperatures above 26°C, though the humidity can be up to 90% in some of the hardrock mines. Rescue men who normally work at the mine will be well acclimatized to the normal conditions. This situation is very different from the European coal mines which can be very hot and humid and where permanent rescue men employed at the stations are not subject to these conditions daily. One can understand that hot/humid chambers might be useful as a means of acclimatization though experience shows that full acclimatization to hot, humid, conditions may take more than ten to fifteen days but can be lost in about five days.

The use of hot chambers is useful in simulating the conditions under which underground fires are dealt with. The chambers enable the rescue workers to test their fire fighting capabilities and to use breathing apparatus under realistic conditions. The desirability of this type of training chamber in Canada needs to be evaluated. If it can be shown to be of benefit, a simple, cheap, but effective design for mine-site units would be needed. A pilot unit would be necessary, followed by field trials. This could be considered as a research project for CANMET.

Training Manuals

The training manuals used in the various Provinces vary less in content that in presentation. There is much to commend standardization of training manuals principally because the standardization of other things can only follow standard training courses. The suggestion that manuals be developed using the module approach, as the training manuals of the University of West Virginia do, was seen to have the following advantages.

a) As new apparatus comes into use, a training module dealing with testing, maintenance and operation, can be prepared without writing a completely new manual.

b) Modules will be prepared for different aspects of mine rescue and for different pieces of apparatus and equipment. A mine may not use all the modules, and it would select only those which are applicable to its own circumstances.

c) Training modules can be drawn up for emergency training of new workers and supervisors.

d) Although different Provinces may designate the modules to be used in specific circumstances at least everyone would be trained in the same way for the same apparatus or activity.

When preparing manuals, the script should be concise, oversimplification should be avoided. It leads to confusion because of incomplete explanations and the inadvertant use of incorrect statements. Writing training manuals for industrial workers requires input from people experienced in adult education, as well as being knowledgeable in the subject being taught. It is not a task that can be easily accomplished on a part-time committee basis, as past experience in Canada has shown.

The modular training manuals prepared by the University of West Virginia are an example of how a module approach should be used. Each module could contain detailed schedules of practical work and lectures. An instructor's handbook should be included with each module.

The possibilities of using the existing training modules prepared by U. of W.Va. should be explored. There is little value in pursuing the preparation of a Canadian manual (which was to be in a modular form anyway) when the same work has already been done elsewhere. The use of these modules should not prevent additional modules from being prepared which deal with matters of specific interest to Canadian Mines. Perhaps the appropriate authorities of the U. of W.Va. should be approached by CANMET to explore the usefulness of cooperation in other aspects of mine rescue training.

For example:- Emergency training for new workers
- Crisis management for managers
- Emergency training for supervisors
- Use of special equipment

6.6.3 Training Mine Rescue Instructors

The quality of training which rescue workers receive is the responsibility of the designated company and government instructors. These instructors play a most important role in mine rescue. Their dedication to their work and their valuable experience have been of tremendous help to mine rescue. They have few didactic aids other than manuals and practice apparatus. Unfortunately, no special training or instructions is available to the instructors. There should be established at least one national centre where attention can be given to Instructor training and the preparation of instructional aids such as films, models and material dealing with special equipment and techniques.

6.6.4 Mine Rescue Competitions

The District and Provincial Competions are accepted all across Canada as being a powerful motivating force for mine rescue training. It seems that the efforts of Provincial Chief Inspectors over the last few years have not resulted in agreement from all Provinces to participate in annual Canadian National Championships. It appears that discussions, up to now, have been between Inspectors and other Provincial Officers. Little attention has been paid to the view of the mine operators who, in most cases, are paying the costs either directly or indirectly and whose employees are absent during the competition. If the Canadian mining industry is not generally supportive and a committment to participate from at least eight of the mining Provinces and Territories cannot be obtained then perhaps the idea of a full Canadian Competition should not be pursued further. Those who are already participating will no doubt continue with the present competition arrangements.

Provincial and Territorial Chief Inspectors should look more seriously at the formation of a National Mine Rescue Association to supplement the contribution made by competitions to improving rescue skills. This Association would provide a forum for discussion, making up for the absence of the informal technical exchanges and discussions which would form part of a National Mine Rescue Competition meeting.

Membership in a Rescue Association would include the following people:

a) Chief Inspectors
b) Mine Rescue Instructors
c) Mine Rescue workers
d) Technical personnel concerned with mine safety and rescue work
e) Manufacturers and supplies of rescue apparatus and equipment
f) Mining companies (as corporate members)

The Association would organize technical conferences including an annual National Conference and would publish a Mine Rescue Bulletin, perhaps quarterly would be sufficient. Such a publication would offer technical articles and provide a means for all to express their views on certain matters. It would also stimulate interest in research and development as it affects mine rescue.

SECTION 7
MINE RESCUE EQUIPMENT

7.1 PRINCIPAL SUPPLIERS AND DISTRIBUTORS

The Canadian distributors of breathing apparatus and equipment for mine rescue, are the principal safety equipment houses for the following:

a) Mine Safety Appliances (M.S.A.)
b) National Mine Services (N.M.S.)
c) Safety Supply Canada
d) Levitt Safety
e) Canwest Safety Service Supplies Limited

There are also U.S. distributors, some of whom handle the same or similar products as their Canadian counterparts, but usually do not compete with them for the distribution, sale and service in Canada. These companies supply all types of safety equipment, from safety slings stretchers and first aid supplies to gas testing equipment, self rescuers and breathing apparatus. The following is a list of U.S. suppliers:

a) Mine Safety Appliances Co.
Pittsburgh, Pa.
b) National Mine Service Co.
Pittsburgh, Pa.
c) Haskell Inc. U.S.
d) Bio Marine Industries Inc.
Milwaukee, Wisconsin

There are no manufacturers of mine respiratory apparatus in Canada, all are imported. The main manufacturers who supply Canada are usually German or American, although some British liquid oxygen apparatus is used.

7.2 RESPIRATORY EQUIPMENT

7.2.1 Introduction

The chart on the following page is taken from the B.C. "General Underground Mine Rescue Manual". It illustrates the relationship between different forms of respiratory protection. On the next page is a photocpy of an extract from the Univ. of W.Va. training module in which some useful definitions are given.

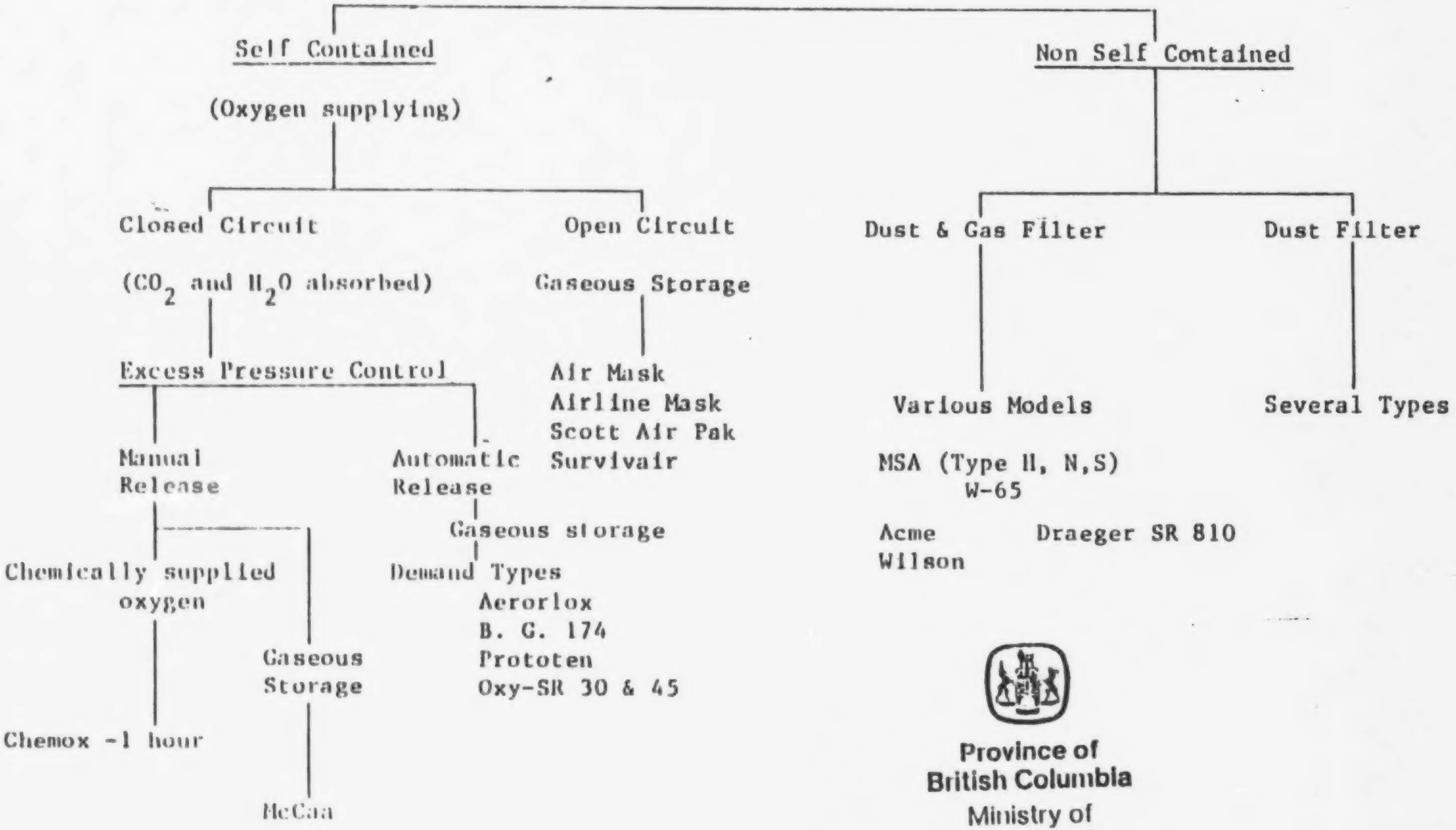
The closed circuit S.C.B.A. most commonly used in Canada's underground mines as the primary breathing apparatus is the Drager BG 174. There are also a limited number of Aerolox and McCaa units in use. Auxilliary units which are now popular are the OXY-SR's, the Scott Air Paks, and the Survivair units. The Chemox and 'N' type apparatus are used but are now being replaced by newer types. B.C. no longer accepts the Chemox apparatus. Ontario has no filter type self rescuers in use, only the OXY-SR 45 oxygen re-circulating type, neither do they accept the chemical oxygen generating apparatus. Manitoba is the same as Ontario. It uses only OXY-SR 30 and 45 type self rescuers. Quebec, Manitoba and Ontario are all using Type 'N" masks. Quebec has some filter self rescuers where some mines own their own. The OXY-SR 45 apparatus is carried only by mine rescue teams; no oxygen generating types are used.

The compressed air or oxygen supplying apparatus is becoming favoured over the apparatus which generates the oxygen chemically. The types being favoured are:

a) 30 min. Demand air (Scott air paks)
b) MSA air masks.

The most commonly used closed circuit S.C.B.A. across Canada is the BG 174. This apparatus has been tested and approved as safe for up to 4

RESPIRATORY PROTECTIVE EQUIPMENT


Self Contained
(Oxygen supplying)
Closed Circuit
(CO_2 and H_2O absorbed)
Excess Pressure Control
Manual Release
Chemically supplied oxygen
Chemox -1 hour
Gaseous Storage
McCaa
Automatic Release
Gaseous storage
Demand Types
Aerorlox
B. G. 174
Prototen
Oxy-SR 30 & 45
Open Circuit
Gaseous Storage
Air Mask
Airline Mask
Scott Air Pak
Survivair
Non Self Contained
Dust & Gas Filter
Various Models
MSA (Type H, N,S)
W-65
Acme
Wilson
Draeger SR 810
Dust Filter
Several Types

Province of
British Columbia
Ministry of
Mines and
Petroleum Resources

INSPECTION AND ENGINEERING DIVISION

SELF-CONTAINED BREATHING APPARATUS (SCBA)

A self-contained breathing apparatus is a completely portable unit that supplies you with oxygen or air independently of the surrounding atmosphere.

Open and Closed Circuit SCBA

Self-contained breathing apparatus can be divided into two main categories: open circuit systems and closed circuit systems. The basic difference between the two systems is this: An open circuit system releases all of your exhaled air (carbon dioxide) to the outside atmosphere through a valve in the facepiece, and supplies you with fresh air to breathe.

A closed circuit system does not release the exhaled air. Rather, it recirculates the air through the apparatus and purifies the air, taking out the carbon dioxide and adding fresh oxygen to the air. You are then supplied with the air that has been oxygen enriched.

Primary and Auxiliary SCBA

In mine rescue work, apparatus are classified as being either "primary" or "auxiliary" apparatus depending on how much air or oxygen they can supply to you when you wear them. Primary apparatus are apparatus that have a minimum of 2 hours' service time. Auxiliary apparatus are units which provide, by law, 30 to 60 minutes' service time.

Primary apparatus are the standard apparatus that mine rescue teams use. Part 49 of Title 30 of the Code of Federal Regulations (30 CFR) specifies that rescue teams must be provided with self-contained breathing apparatus that have at least a 2-hour service time and are approved under Federal guidelines.

continuous hours. Some of the other breathing units are only approved for 2 hours of continuous use.

In addition to the actual breathing apparatus, there are various types of ancillary equipment used for testing, maintaining and replenishing canisters as well as refilling gas bottles. The illustrations in Appendix VII, Section 7.2 show the main types of apparatus and equipment in use.

7.2.2 Closed Circuit, S.C.B.A.

While primary S.C.B.A. are designed for a 2 hour duration, the newer 4 hour apparatus is becoming the standard as mine workings become more extensive. The following extract from a report by G.G. McPhail* concerns a fire at the McIntyre Porcupine Gold Mine, Timmins, 1965, illustrates this need very well.

> "The major result of this fire was the decision of the Ontario Mining Assocation to request the Ontario Department of Mines to investigate some of the newer, longer-lived breathing apparatus on the market, with a view of replacing the McCaa apparatus. It was felt that while the McCaa has performed an excellent role in mine rescue work for 35 years, some of Ontario's mines have simply outgrown it. This was dramatically proved early in the McIntyre fire as a number of teams did not reach the fire before the reduction in their oxygen supply forced them to return to surface. This was not only a drastic waste of time, but allowed the fire time to get out of control again, and many McCaa cylinders reached dangerously low levels of pressure as the wearers reached surface.

* "Plan for Survival" at the Hardrock Metal Mines in Ontario: G.G. McPhail, Retired Senior Mine Rescue Officer, Ontario. Presented at the International Crisis Management Symposium, Sydney, N.S., Oct. 1982.

> **This inability of rescue teams to reach the fire area and to apply any effective control measures early in the operation certainly prolonged the ordeal at McIntyre by many hours. This too necessitated many additional hazardous trips by rescue crews, who in trying to make even a little progress sometimes delayed their return trip beyond safe limits.**
>
> **The main purpose of a 4-hour breathing apparatus is to provide a comfortable margin of safety for travelling, and still allow some time to produce effective results in rescue operations or in fire control in deep mines."**

7.2.3 Self Rescuers

Self rescuers fall into two main categories:

a) filter type
b) oxygen type

The filter type are designed to protect the wearer from smoke and carbon monoxide. They are only of use when the atmosphere contains sufficient oxygen for survival. They are carried in a container by the miner at all times until required, and then they can be quickly withdrawn and donned. The self rescuer enables the miner to leave a location where the atmosphere is hazardous because of smoke, or CO, and seek refuge in a safer area, perhaps in an intake airway.

The use of filter type self rescuers is mandatory in European, U.S. and Canadian coal mines. Canadian metal mines have found that, in the daily presence of sulfide orebodies, and in the mounting and descending of raises, the filter self rescuer is troublesome and difficult to maintain in working order. Hardrock mines have not pressed the use of this type of self rescuer and have turned instead to the oxygen types, notably the Oxy-SR 30 and Oxy-SR 45, of 30 min. and 45 min. duration respectively.

The SR 45 apparatus has become standard equipment for the rescue teams. Its purpose is to enable the team to bring victims through irrespirable atmospheres to safety. It can also be used for a spare should a team members' apparatus fail or be damaged during an emergency.

The table on the following page (Table 7.1) is reproduced from the "Coal Age" publication and compares the main types of self contained self rescuers in use.

TABLE 7-1
COMPARISON OF SELF RESCUERS
(Reproduced from "COAL AGE")

Manufacturer	Draegerwerk AG Lübeck, Germany Sole U.S. Distributor: National Mine Service Co. 4900/600 Grant St. Pittsburgh, Pa. 15219	Mine Safety Appliances Co. 600 Penn Center Blvd. Pittsburgh, Pa. 15235	Portable Air Supply System (PASS) 720 Bolivar Rd. Cleveland, Ohio 44115	CSE Corp. 600 Seco Rd. Monroeville, Pa. 15146	Ocenco, Inc. 400 Academy Drive Northbrook, Ill. 60062
Model Number	OXY-SR 60B.	SCSR-60	700	AU-9A1	EBA6.5
Weight: Carry Use	8.5 lb 7.5 lb	9.1 lb 6.5 lb	19.5 lb in carrying case 14.5 lb use	11.3 lb 10.0 lb	7.5 lb 6.5 lb
Dimensions	8.7 x 5.0 x 11.8"	10.5 x 3.6 x 10.7"	14.5 x 7.5 x 19.5" 11.25 x 6 x 17"	6.5 x 4.5 x 11.5"	8.6 x 11.9 x 4.6"
MSHA/NIOSH approval	Yes	Yes	Yes - with special storage case only, which can be mounted on mining equipment	Yes	Yes
Oxygen source	Pelletized KO$_2$	Granulated KO$_2$	High-pressure oxygen-2000 psi	High-pressure oxygen-3500 psi	High-pressure oxygen-3000 psi
CO$_2$ scrubber	Not required	Not required	Soda lime	Lithium hydroxide	Lithium hydroxide
Oxygen flow rate	Demand responsive	Demand responsive	3.2 liters per minute constant flow	1.6 liters per minute constant flow with demand valve	1.6 liters per minute constant flow with a minimum of 30 liters per minute upon demand
Maximum storage temperature	158°F	100°F	100°F	120°F	140°F
Minimum storage temperature	+23°F	+10°F	+32°F	+14°F	+10°F
Maximum duration, based on NIOSH Man-Test No. 5	5.5 hours	5.0 hours	70 minutes	7 hours manipulating valve	7 hours manipulating valve
Breathing bag location	Top of rescuer, between chest and head	Two bags located on either side of rescuer	Enclosed within rescuer	Bottom and side of rescuer	Front of rescuer
Gas-tight goggles	Yes	Yes	Yes	Yes	Yes
Outer housing	Polypropylene	Steel	Plastic and Aluminum	Aluminum	Polycarbonate
Separate training unit available	Yes	Yes	Yes	No**	Yes
Reserviceable	Yes	No	Yes	Yes***	Yes

*Each manufacturer provided his own data.

**A training unit is available. Regular unit can be converted to a training unit and then reconverted back to regular unit. Either unit will train miner under oxygen.

***Can be reserviced by mine operator.

In German mines, the Oxy SR 45 and Auer SSR-120 oxygen generating type self rescuers are used extensively. Records show that filter self rescuers have been effective in over 500 escape situations and are credited with saving the lives of over 1000 miners from CO poisoning. Plans have been formulated to locate the oxygen generating type self rescuers in special working areas such as long roadways and remote sections of the mine.

The introduction of the Oxy-SR's has not been without problems, as the "Coal Age" article "Industry Wins Reprieve on Deadline for Self Rescuers" (Jan. 1981) and the note on defective self rescuers show (See following page).

During this survey, the following difficulties were reported with Oxy-SR's:

a) The small oxygen valve is too small to be manipulated with ease.

b) The device is not easily unpacked and put into use, neither is it easy to re-pack.

c) There are occasional problems with the degradation of the breathing bag, hoses and masks.

7.2.4 Air Packs

This breathing apparatus consists of a face mask, mouth piece, hoses, valves, and an air supply from tanks filled with compressed air. The tanks are carried usually on the back, in a harness supported from the shoulders. The Scott Air Pak is a typical example of this apparatus.

Industry Wins Reprieve on Deadline for Self-rescuers

COAL AGE/JANUARY, 198

A federal decision to delay the Dec. 21, 1980, deadline for installing oxygen producing "self-rescuers" in the nation's coal mines until June 21, 1981, has been called by the United Mine Workers of America "a careless disregard of coal miners' safety needs [and] the result of wanton and callous profit motivations on the part of the Bituminous Coal Operators' Association (BCOA) and the American Mining Congress (AMC)."

Self-rescuer: six-month delay

Both operator-sponsored groups say they asked the Department of Labor to postpone enacting a 1969 mandate requiring perfection of an oxygen pack by Dec. 21, 1980. Further testing is needed, the operators say. Industry leaders contend that the new device, which is supposed to protect miners from asphyxiation in mine fires by creating an oxygen supply good for up to six hours, itself may be a fire hazard. They add regulations requiring the 8.5-lb. pack to be worn or stored within 25 ft. of the miner aren't practical.

Stalling charged

A spokesman for one of two companies presently manufacturing the oxygen mask calls the demand for further testing "a stalling mechanism" and says the U.S. Bureau of Mines reported in October, 1980, that the oxygen units were rugged and that potassium superoxide, a chemical that can cause fire, is relatively stable. He believes the delay was the work of a few companies—including the Consolidation Coal Co.—that pressured Assistant Secretary of Labor Robert B. Lagather to put off installing the breathers because "for one, they are $400 apiece, and the switch would cost industry about $70 million in training and equipment." Masks now in use run about $50 apiece.

He added the one failure cited with the new equipment was because a miner did not have his mask on properly.

But Ralph Hatch, vice president of Safety at Consolidation Coal Co., countered that if a feeder-crusher in a mine pierced an oxygen can, a fire or explosion could result. "It might ignite methane and coal dust, and a combination of gas, coal dust and oxygen is very dangerous," he said. "According to a study done by the National Bureau of Mines, it could cause a mine fire once every eight years."

He added that his firm was 100% in favor of "a new device which does more than what we have now" and that the present rescuer, which makes carbon dioxide from carbon monoxide, builds heat and has been known to blister a coal miner's mouth. "He spits it out and he's dead," Hatch admitted, "but we're still not satisfied the new device is safe."

A BCOA spokesman commented that questions such as how the nine-pound pack will be stored, and who should have access to the cache must be answered before it becomes mandatory in the mines. "Money is not an issue. The only issue is safety versus risk," he said.

Lagather, who has pushed for the oxygen breather for years, says he delayed its installation because of minor concerns by BCOA, AMC, and other industry leaders, and is now doing further field testing "to satisfy everyone." He promises "the devices will go into the mines if it's the last thing I do before leaving office.

"Qualms from operators come from the misunderstanding that everyone will have to wear a mask, whereas if they're stored where they're accessible, they will meet regulations. That distance varies from mine to mine," the undersecretary added. ∎

Kentucky Self-rescuers Defective

As many as 240 of 300 self-contained self-rescuers purchased by Leeco Coal Co. at London, Ky., have been found to be faulty.

The self-rescuers, designed to provide underground coal miners with a supply of oxygen in the event of a mine fire or explosion have holes in an inflatable bag attached to an oxygen container. Leeco's safety director believes the defects resulted from a manufacturing problem.

Samuel Shearer, president of CSE Corp., which manufactured the devices, said his company has not taken a position on the cause of the problem and the firm has initiated an investigation into the faulty self-rescuers. Shearer said he knows of no other self-rescuers made by CSE that have been reported as faulty.

He said the bags on the CSE equipment are not manufactured by his company, but he declined to identify the maker.

Federal law requires underground mines to have the devices that can provide at least one hour of oxygen supply. Shearer said his firm has been in contact with the Mine Safety and Health Administration about the rescuers purchased by Leeco. "They are aware of the problems at Leeco, but that is about the only thing that has transpired so far," he said.

Officials of coal operators' associations in the Eastern Kentucky coalfield said they know of no other companies having difficulties.

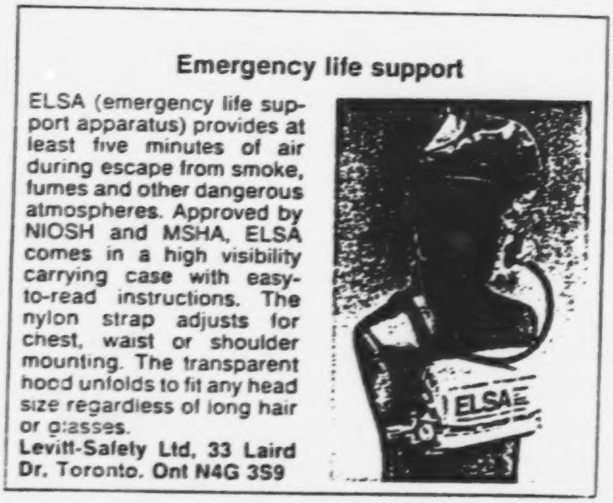
Federal officials have made no determination of the cause of the problem with the Leeco devices. ∎

The demand air (Scott air pak) apparatus is finding increasing use in hardrock mines. It is used like the SR 45 to rescue victims, but more commonly, it is provided at underground shafts for use by cagetenders and underground hoistmen. The apparatus enables them to man their posts, even in smoke, so that they can draw men up, to escape from the lower workings of a mine during a fire. These precautions became the rule after a disasterous loss of life in the Kellog mine, Idaho. Men died when the shaft hoisting personnel had to abandon their posts because of smoke.

In Ontario, a system is being used which enables cagetenders and hoistmen to connect their demand air apparatus to "jumbo" air cylinders, thereby extending their normal 30 minute duration. A similar facility is being developed for the use of underground mobile equipment operators.

The air paks are also used in short term emergency operations and for investigating problem areas such as heating of sulphide ore in ore pockets and examining stopes and raises. They are particularly useful in short investigations where the BG 174 apparatus is heavy and cumbersome to use.

A recent development in air apparatus is the emergency life support apparatus supplied by Levitt-Safety Ltd. of Toronto. This apparatus should perhaps be considered as an air supply self rescuer. It has a minimum duration of five minutes.



Emergency life support

ELSA (emergency life support apparatus) provides at least five minutes of air during escape from smoke, fumes and other dangerous atmospheres. Approved by NIOSH and MSHA, ELSA comes in a high visibility carrying case with easy-to-read instructions. The nylon strap adjusts for chest, waist or shoulder mounting. The transparent hood unfolds to fit any head size regardless of long hair or glasses.

Levitt-Safety Ltd, 33 Laird Dr. Toronto. Ont N4G 3S9

7.3 MAINTENANCE OF APPARATUS AND EQUIPMENT

7.3.1 Records

The care and maintenance of the mine rescue supplies, apparatus and equipment, are the responsibility of the mine rescue instructors, trainers and coordinators, who may be government or company employees. It is the duty of the Government Inspectorate and Rescue Superintendents to ensure that the work is correctly carried out and recorded. Appendix VII, Section 7.3 gives examples of the maintenance records kept in different provinces.

7.3.2 Organization - Ontario Example

The maintenance organization in Ontario is given as an example of what is required to ensure that all apparatus is safe and ready for use at all times.

In Ontario, all repairs, replacement of parts, testing and calibrating of all apparatus is done by the Ontario Mine Rescue Officers.

The seven main mine rescue stations serve a multi-purpose function. In addition to being training bases and responding to emergencies, they also act as supply depots for the satellite substations. Each main rescue station is a designated central service base for an individual apparatus. The Sudbury mine rescue station is the central base for calibrating and servicing the Drager BG 174 oxygen control and valve assemblies. The Onaping station is the centre for the calibration and servicing of the Drager OXY-SR 45 apparatus. The Kirkland Lake station is the centre for calibrating and servicing the demand apparatus regulator assemblies. These three station are also responsible for the inventory of parts for the particular apparatus serviced. The Elliot Lake station carries an inventory of parts for the high pressure oxygen pumps. The Timmins station, in addition to doing regular service, is listed as the central warehouse and carries a large inventory of parts and supplies such as Type N and Drager 4 hour canisters, breathing bags, facepieces, hoses etc. which require a periodic turnover and may be required in abundance during emergencies. A limited stock of parts is maintained at each station and replacements are drawn from the central warehouse.

7.3.3 Apparatus Technicians

The job of an apparatus technician encompasses the following duties:

a) Maintain sufficient apparatus and equipment in a state of readiness to allow the rescue team(s) to be equipped for duty without delay.

b) Maintain an adequate level of parts and replacements and arrange their proper storage and documentation.

c) Take care of checking, cleaning, disinfecting and testing of all apparatus after use.

d) Take care to check, test, and prepare all apparatus and equipment for use.

These duties are similar to those performed by the Mine Rescue Officer (superintendent or coordinator) at Canadian Rescue Stations. The Mine Rescue Officer at the mine site has the same duties as mentioned above, but also must train the rescue teams. A Canadian Rescue Station, mine site or otherwise, is small compared to those of Europe where the apparatus is not normally kept at the mine, but maintained at a central station which serves a considerable number of mines. In consequence, the maintenance task of a Canadian Mine Rescue officer is much lighter and he is able to carry out additional duties.

The concept of an Apparatus Technician differs from current Canadian practice in the tasks mentioned in items (c) and (d) above. So far as attending to equipment after use is concerned, few would disagree that, a team who has just completed a spell of work "under oxygen", should not be faced with having to clean and prepare their apparatus for further use. On the other hand, this survey found mixed reactions to the idea of technicians preparing apparatus for use, so that all the team had to do was put it on the apparatus and go. The use of a technician was said to have the following advantages:

a) Valuable time is saved.
b) The nervous tension of a team preparing to go into action is not conducive to a rescue man giving his undivided attention and concentration to preparing his apparatus.

The opponents to the use of Apparatus Technicians say that:

a) The possibility of mistakes or an item being forgotten are completely avoided by the use of a Bench Test Drill and mutual checking between team members. This procedure is by-passed when a technician is used.
b) No one will give the same care and attention to checking the apparatus as the one who will wear it.

There were few Canadian mine rescue officials, either from government or industry, who were in favour of the Apparatus Technician concept; most were decidedly opposed to it.

7.4 APPARATUS DEVELOPMENTS

It is understood that Mine Safty Appliances M.S.A. (U.S.) and the Bio Marine Co. (U.S.A.) are both in the process of developing 4 hour closed circuit self contained breathing apparatus. In the U.K., both the Proto Mk IV and the Aerolox have proved satisfactory over the years. It is understood that discussions with various apparatus manufacturers are being held with a view to producing an N.C.B. designed apparatus. Details cannot be obtained, but it is believed that manufacture of prototypes will begin in the near future. If this new appartus is of the liquid oxygen type it will be of limited interest to Canada because of the difficulties in storing and transporting oxygen in this form.

During the visit to Great Britain, the intention was to visit both the Safety in Mines Research Establishment (SMRE), who had developed the original liquid oxygen apparatus, and the works of Siebe-Gorman who manufactured it. However, mine rescue officials at the N.C.B. advised against this, saying that the only current developments were being carried out by the N.C.B. and details of the new apparatus would be disclosed at the appropriate time.

Information received from Germany concerning the developments taking place at Drager were given as follows:

a) Improvements to the Oxy-SR 45, mainly in the materials used in the construction of the face mask, breathing bag and hoses. A different type of rubber is used to obtain greater durability and freedom from allergic reactions.
b) Improvements to the present B.G. 174 are planned for the face mask, breathing bag, and hose material. There will also be improvements in the arrangement of certain fittings. Different materials are used in some fittings - stainless steel in place of silver, and an alternative material for the aluminum cover.
c) Further developments in the use of face masks and hoses.
d) A filter type self rescuer (FSR 950) will have a new absorbent to increase gas protection and a new stainless steel container.

There is a distinct trend towards increased use of oxygen self rescuers for increasing duration and toughness. An apparatus to last 90 minutes is now being tested, and even one of a combined short and long duration. The problems that were experienced with the SR 30 and SR 45 units, along with safety concerns about the oxygen generating chemicals used in them is leading to the development of rigorous testing procedures. (See following pages)

Technology News

From the Bureau of Mines, United States Department of the Interior

7-17

Technology News describes tested developments from the Bureau of Mines Research Programs. It is published to encourage the transfer of this information to the minerals industry and its application in commercial practice. Mention of company or product names is for documentation only and does not imply government endorsement of a specific firm or product.

Bureau of Mines research is performed and reported under mandate of the United States Congress. For a free subscription to Technology News, write to: Technology Transfer Group, Bureau of Mines, 2401 E St., NW, Washington, D.C. 20241.

No. 105, May 1981

Combined Short- and Long-Duration Oxygen Self-Rescuer

Objective

Provide respiratory protection for escape in a toxic or oxygen-deficient atmosphere with a device small and light enough to be belt-worn.

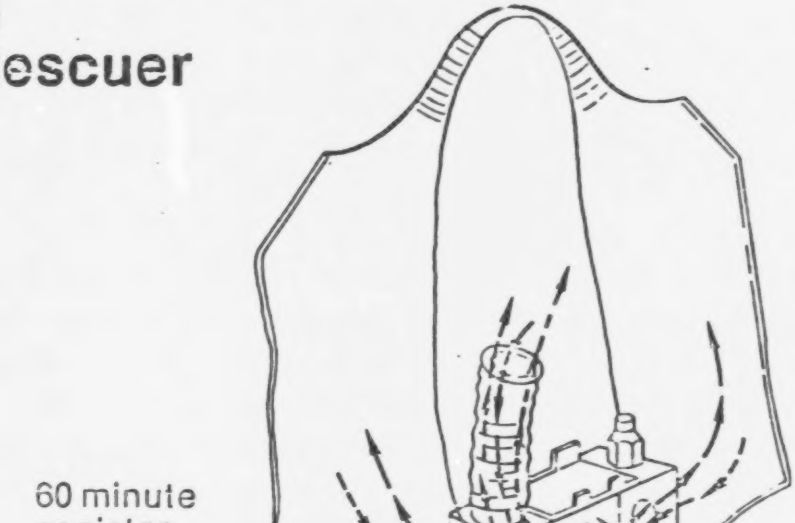
Approach

Combine a 10-minute, belt-worn respirator with a stored, larger, long-duration (60-minute) attachment that can be plugged into the 10-minute unit without removing the mouthpiece.

How It Works

The 10-minute device will be carried by the miner at all times, and the 60-minute canister or attachment will be stored near the miner. In the event of a disaster, the 10-minute device would be donned immediately. The miner would then proceed to the stored 60-minute unit and plug it into the 10-minute unit.

For the 10-minute unit, a breathing circuit was developed in which air is passed through the KO_2 bed twice per respiration. The 60-minute canister differs from the 10-minute unit in that air is drawn only once through the chemical bed per respira-



Flow path of air through 10/60 system.

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tion. This was necessary to keep the inhaled air temperature within Federal approval requirements.

A 6-cm finned aluminum cylinder located in the breathing tube acts as a heat exchanger in the 10-minute device. Location of the heat exchanger in the breathing tube also prevents the breathing tube from closing. The breathing bag and manifold in the 60-minute unit are used as the primary heat exchanger. Inhalation temperature is reduced to about 43°C (109°F), a temperature that is easily tolerated by a wearer. Canister wall temperatures reach approximately 120°C (248°F). To protect the user from burns, both canisters have a felt protective cover.

Operation of the system involves connecting the 10-minute and 60-minute canisters in a hazardous environment while minimizing trapped gases. The drawing shows the flow path through the 10/60 system.

The manifold system is designed to limit the inhaled concentration to less than 50 ppm carbon monoxide if the coupling is performed in a mine atmosphere contaminated with 2.5 percent carbon monoxide. The canisters have hermetic seals over their coupling ports. As the 60-minute canister fittings are pressed against the 10-minute canister, a metal-to-metal seal is made between the ducts prior to opening of either of the individual hermetic seals. Initial rotation of the handle on the latch assembly secures the metal-to-metal seal between the canisters. Further rotation punctures the hermetic seals and activates the 10-minute canister shutoff valve.

Testing

The 10/60 system has been extensively machine- and man-tested. The results of these tests indicate the unit will last 60 to 270 minutes depending on the work rates. In addition, these tests show that an escaping miner could travel over 7 km while using the 10/60 system. The unit has been tested by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration, and has received prototype approval for use in mines. The system is not yet available commercially because its cost implies a limited industrial market. It was developed by Mine Safety Appliances under contract to the Bureau of Mines of the U.S. Department of the Interior.

The advantages of oxygen self-rescuers has led the Mine Safety and Health Administration to promulgate regulations requiring the use of self-contained oxygen self-rescuers for coal mining. It is expected that these regulations will be extended to noncoal mining operations in the future.

Further testing of this development was done by the Pennsylvania State University. The Technical Project Officer for the 10/60 apparatus is Jerry W. Stengel of the Bureau's Pittsburgh Research Center.

Patent Status

Mine Safety Appliances Company holds U.S. Patent #3,930,081 on the 10/60 apparatus.

For More Information

For more information regarding this project, please contact:

Technology Transfer Officer
Pittsburgh Research Center
Cochrans Mill Road
P.O. Box 18070
Pittsburgh, PA 15326

The 10/60 Oxygen Self-Rescuer System

			Service Life (minutes)	
Device	Volume (cm³)	Weight (kg)	Trapped Miner (Sitting)	Heavy Work (Escape)
10-minute	2,170	2.175 packaged 1.61 used	30-45	10
60-minute	3,900	3.58	240-300	60
10/60		5.20 used	270-345	70

Breathing apparatus passes tough test

MINING EQUIPMENT INTERNATIONAL

The introduction of new life-support systems for underground coal mining required extreme testing measures to ensure their proper functioning in the most extreme conditions. The U.S.A. Bureau of Mines was one of three agencies to test oxygen chemical self-rescuers from two manufacturers.

Although most miners probably will not shoot their self-contained self-rescuer (SCSR) with a rifle, run over it with a continuous miner, nor put it through a feeder-breaker, they should be happy to know that tests show two of these newly-introduced units can withstand that kind of abuse.

The U.S.A. Bureau of Mines subjected the SCSRs from Draeger (OXY-SR 60 B) and Mine Safety Appliances (60-minute SSR) to a series of harsh environmental and mechanical tests. They consisted of exposure to extreme temperatures, shock, and vibration; exposure to rifle fire, water, and bonfires; simulated roof falls; being run over by various mining machines; and being fed through a feeder-breaker.

The rigorous tests were designed to predict the units' abilities to survive unusually severe conditions with no degradation in their ability to protect their wearers. Although BOM researchers Jerry W. Stengel, Nicholas Kvriazi, and Sarah L. Benz report that the units will withstand abuse and function as intended, long-term field experience is needed to provide confidence in their predictions.

Apparatus such as the SCSR has been required in U.S.A. underground coal mines since this past summer. Each miner must wear, carry, or have immediate access to a self-rescuer that provides an oxygen source. The SCSR replaces filter self-rescuers (FSRs) as primary escape equipment, because the FSR protects only against low levels of carbon monoxide (CO).

Integrity test

BOM researchers began examining the fire and explosion hazards of chemical SCSRs three years ago. The mechanical integrity of the unit's canister was of concern, because potassium superoxide (KO_2), the oxygen-generating chemical would react readily with moisture and any fuel, such as coal.

The results of the mechanical-abuse tests showed that the one-hour self-rescuers were rugged and would probably survive massive roof falls and crushing by mobile equipment without releasing significant, if any, quantities of KO_2. Experiments involving the running over of KO_2/coal mixtures showed that the consequences of KO_2 release under such circumstances would be negligible.

The BOM's test program was a follow-up of tests conducted by the manufacturers and two other U.S.A. governmental agencies. In that follow-up role, the BOM researchers wanted to study the environmental effects of the gradual deterioration that all equipment and materials are expected to experience. The tests also can be of help in estimating the expected service life of the units.

BOM Researchers are planning a long-term field evaluation with two goals in mind. The first is to observe directly the failure mode for a particularly harsh condition if the test is severe enough. The second is to estimate the propriety of the laboratory tests from the field-test results.

Researchers point out, however, that such test results are applicable only to the two chemical O_2 devices tested.

The new units

Self-rescuers in general are a closed-circuit, self-contained breathing apparatus composed of a mouthpiece or facepiece and breathing hose, an oxygen source, a carbon dioxide (CO_2) absorbent, and a breathing bag. With chemical oxygen apparatus, KO_2 is both the oxygen source and the CO_2 absorbent, satisfying human physiological needs with a little excess oxygen. This excess oxygen has the effect of continually purging the system of nitrogen, which may be the breathing loop.

Although the Draeger and MSA SCSRs have different flow paths and component arrangements, their functions are the same. Oxygen self-rescuers are bigger and heavier than filter self-rescuers, and although their temperatures may be high toward the end-of-life, it is unrelated to ambient temperatures. FSRs, on the other hand, may heat to unbearable temperatures and burn the lips of the user if ambient CO concentrations are high.

Another difference between FSRs and SCSRs is the measurement of duration time.

FSR duration is determined by ambient CO concentrations, humidity, and physiological demand. SCSR duration is determined solely by the user's physiological demand. If the user is sedentary, duration could last up to five hours, according to the test of the government agency.

Designing tests

BOM's laboratory testing consisted of two parts: environmentally treating the units and measuring the effects of those treatments on operating life. The treatments considered were temperature extremes of 71°C for 48 hours, 100°C for 4 hours, and −45°C for 16 hours, and shock and vibration.

Tests were conducted using human subjects and machines. Human subjects were placed on a treadmill, and for the machine tests, a breathing and metabolic simulator (BMS) was used. They measured the environmental treatment effects on SCSR performance.

Human-subject testing provided relevant information on human factors, while the BMS tests provided a more reproducible method for quantifying the duration of respiratory protection. The BMS can be programmed to reproduce a given work load precisely from test to test.

BOM researchers reported two ways in which a self-rescuer could fail: measured parameters could exceed predefined limits or the apparatus could cease to support life completely. In other words, they reported, even though an apparatus could be difficult to breath through and exceed predefined limits, it could be used in a life-and-death situation to escape an irrespirable atmosphere.

Treadmill testing

Treadmill tests with human subjects were used to monitor CO_2 and O_2 measured in the breathing bag and temperature and pressure measured in the mouth bit. At the end of 60 minutes, a constant speed chosen by each subject was maintained until apparatus failure.

Characteristics of new, untreated SCSRs were measured during the human-subject and machine tests. This enabled researchers to establish a normal range of performance and to establish a control for comparing results with those of tests with results for treated SCSRs. The results for each of the human subjects were given a value of 1,00 for duration values, with duration being defined by the termination time.

Factors determining termination were: inhaled gas concentrations of CO_2 greater than 1,5% or of O_2 less than 21%, inadequate gas volume (bag bottoming on inhalation), an excessively high heart rate (greater than 90% of maximum), and any subjective intolerable discomfort, such as breathing resistance, or high temperature of inhaled gas or of the apparatus surface.

All additional testing was done with the BMS, which was programmed with a metabolic state representing a 50th percentile miner. Termination factors were: inhaled gas concentrations of CO_2 higher than 1,5% or of O_2 less than 21% or inadequate gas volume.

For a treatment considered to have no impact on an apparatus, the chlorate candle (starter) had to have been functioning, and there must have been no significant degradation in the duration compared with the control tests.

Shock and vibration

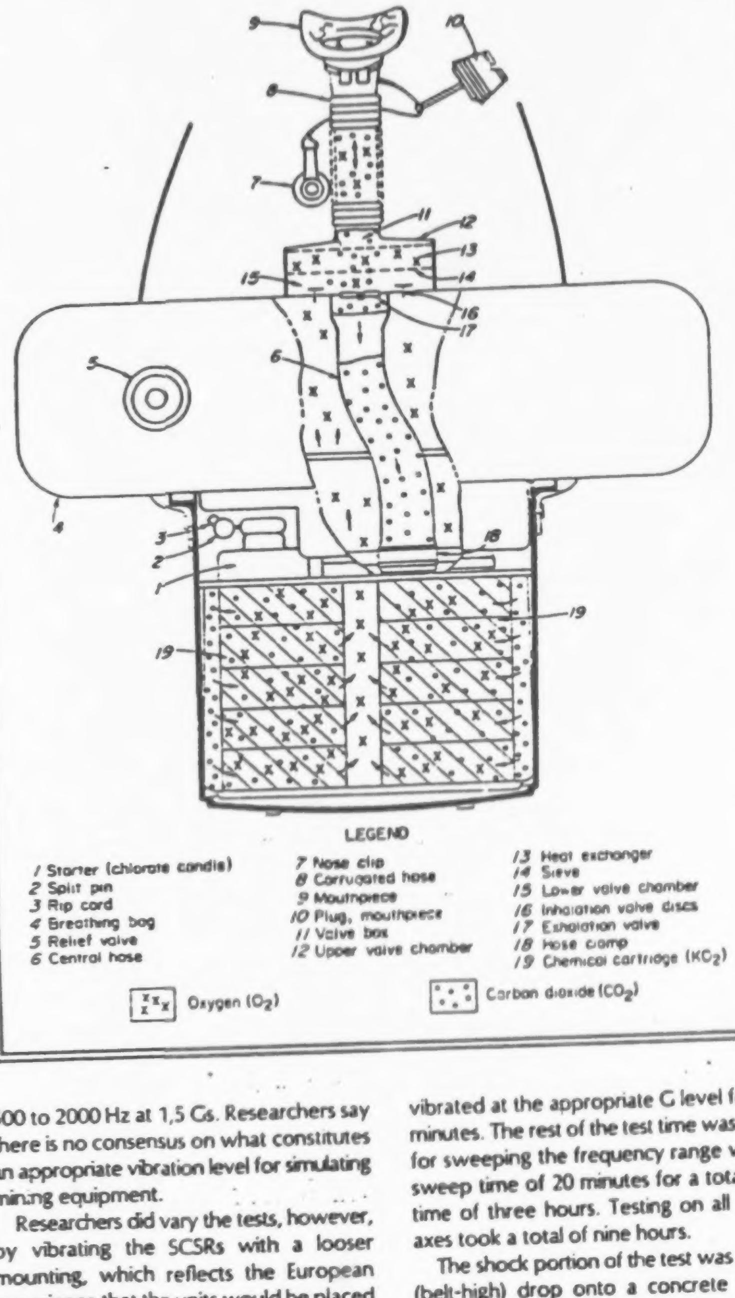
Although federal regulations in the U.S.A. have no specific shock and vibration requirements, one safety agency requires self-rescuers to survive 40 hours of shock and vibration on a Rotap sieve and shaker. The MSA and Draeger units have survived that test.

The Rotap machine subjected the SCSRs to vibration from rotary motion and to impact from a hammer blow at 2.5 impacts/sec. The units were mounted rigidly on the screen to avoid excessive accelerations, and accelerations were monitored to maintain accelerations within 15 Gs from peak to peak during the test. For the SCSRs, the test was based on experience with FSRs, but BOM researchers did not believe that accurately represented conditions on mining machinery.

To resolve this, they devised a composite test based on reported vibration levels with portable equipment, longwall and continuous miners, and underground and surface haulage vehicles.

A shaker table was used for the vibration treatment with motion only along the vertical ("Z") axis. The test conditions were: 5 to 92 Hz in frequency at 2,5 Gs of peak acceleration; 92 to 500 Hz at 3,5 Gs; and

The Draeger OXY-SR 60 B self-rescuer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LEGEND
1 Starter (chlorate candle)
2 Split pin
3 Rip cord
4 Breathing bag
5 Relief valve
6 Central hose
7 Nose clip
8 Corrugated hose
9 Mouthpiece
10 Plug, mouthpiece
11 Valve box
12 Upper valve chamber
13 Heat exchanger
14 Sieve
15 Lower valve chamber
16 Inhalation valve discs
17 Exhalation valve
18 Hose clamp
19 Chemical cartridge (KO2)
Oxygen (O2)
Carbon dioxide (CO2)

500 to 2000 Hz at 1,5 Gs. Researchers say there is no consensus on what constitutes an appropriate vibration level for simulating mining equipment.

Researchers did vary the tests, however, by vibrating the SCSRs with a looser mounting, which reflects the European experience that the units would be placed in unpadded holders if not thrown on surfaces unrestrained. Lateral motion was restricted to ±1 cm.

The control accelerometer was mounted as close as possible to the SCSR without making contact. Another accelerometer was mounted to the top of the SCSR for the "Z" axis, and researchers did resonance searches at an input of 1 G (± peak).

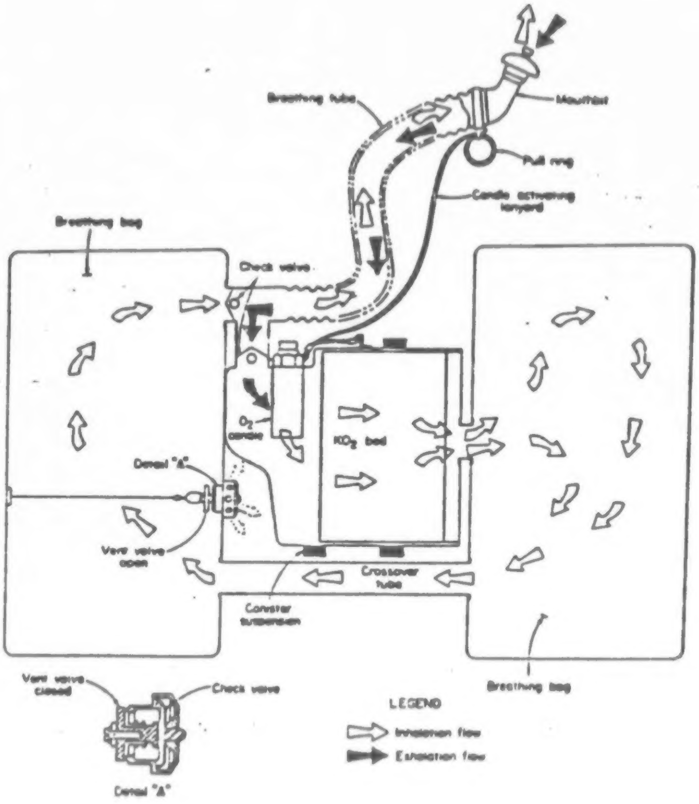
For each resonance, the self-rescuer was vibrated at the appropriate G level for 30 minutes. The rest of the test time was used for sweeping the frequency range with a sweep time of 20 minutes for a total test time of three hours. Testing on all three axes took a total of nine hours.

The shock portion of the test was a 1-m (belt-high) drop onto a concrete floor, performed on each axis. Researchers considered this a realistic worst-case expectation for mine use.

Temperature test

Two high-temperature tests were performed as a research probe. Although researchers do not expect the self-rescuers to operate in such a high-temperature environment, they believed that survival of

The MSA 60-minute SSR self-rescuer


Breathing tube
Mouthbit
Pull ring
Candle activating lanyard
Breathing bag
Check valve
O_2 candle
KO_2 bed
Detail "A"
Vent valve open
Crossover tube
Canister suspension
Breathing bag
Vent valve closed
Check valve
Detail "A"
LEGEND
Inhalation flow
Exhalation flow

these tests increases confidence in their performance. A preheated convection oven was used to heat them to 71°C for four hours and to 100°C for another four.

Three low-temperature tests also were conducted at BOM. In the first of the tests, −45°C was selected as a worst-case condition, and five units from each manufacturer were placed in that temperature for 16 hours and then were brought to equilibrium with room temperature. After the test, three of each manufacturer's units were human tested and the rest were machine tested to see if a one-time exposure to such conditions would degrade the self-rescuers' performance.

The other two cold-temperature tests were made with modified units, which enabled researchers to monitor temperatures in the KO_2 bed continuously. They wanted to determine the average time needed to reach the manufacturer's recommended lowest operating temperature (MRLOT) and to reach BOM's recommended minimum storage temperature.

In one of the modified-unit tests, units were precooled for 16 hours at −45°C and placed in a 0°C environment. The time to reach MRLOT was recorded. This test was designed to provide the user with an average time at 0°C that the unit should be removed from service if it is exposed to a long-term deviation from MRLOT.

The other modified-unit test was designed as a worst-case test. Units were precooled at 0°C for 16 hours, transferred to a −45°C environment for one hour, and placed in a 0°C environment again until they reached MRLOT.

Conclusions

In the treadmill tests, the Draeger units were treated most severely in the 100°C heating for four hours. Heating changed the physical characteristics of the goggles and the three inhalation valves at the breathing bag/breathing tube interface. Where warped, the valves permitted the exhaled gas to flow into the breathing bag, where gas concentration was measured continuously. Manual startings of the apparatus were required because of chlorate candle failure.

Although these tests were considered technical failures, BOM researchers report that the Draeger units would have successfully protected miners in two cases and would have protected the third with physiological side effects.

The shock and vibration tests were the most severe for the MSA unit. A coughing problem in the control and treated units became more severe for the vibrated units, leading subjects to take outside breaths and exhale through the unit to clear it of what was believed to be KO_2 dust. Researchers found that inhaling directly from the KO_2 canister caused coughing, and they believe a more effective KO_2-bed filter would solve the problem.

On the shock tests, several of the canister assemblies became detached from the frames and had to be tied with wire in some cases.

In the BMS tests, the Draeger units experienced similar problems to those in the treadmill tests, but in the overall analysis, the BOM researchers judged both SCSRs as capable of withstanding the mining environment and its possibly harsh extremes of temperature and abuse. ●

Contrôles stricts pour les appareils de respiration

L'introduction de nouveaux systèmes de sauvatage de vies humaines dans les mines de charbon au fond nécessite des méthodes spéciales de contrôle de leur parfait fonctionnement même à des conditions extrêmes d'utilisation.

Equipos de respiración pasan una dura prueba

La introducción de nuevos sistemas de salvamento para explotaciones mineras subterráneas requiere practicar extremas medidas de ensayo para asegurar que su funcionamiento se apropia incluso bajo las más extremas condiciones.

7.5 STANDARDIZATION OF EQUIPMENT

7.5.1 Advantages and Disadvantages

The advantages of standardizing the apparatus used throughout Canada are voiced from time to time. It is said that:

a) the bench drill training can be standarized
b) there will be improved interchangeability of parts between Provinces with the possibility of reducing the total parts inventory
c) there will be more flexibility in the inter Provincial deployment of teams.

In considering the above comments, one should remember that almost all jurisdictions in Canada use the BG 174 so that standarization is virtually in place. In spite of this, there is not total agreement on bench test drill procedures. The apparatus suppliers have always shown a high degree of responsibility and effort to ensure that parts are held in stock and available at all times. In cases of emergency they have made special efforts to meet industry's needs.

The danger of too much standarization is that it may lead to a stifling of the development of better equipment. The manufacturer of a new design will have difficulty in getting his product accepted because it would upset the standardization. The result is that the established equipment continues to be used even though the technology exists to produce a better design. When the need for new equipment becomes obvious, development may have to come from the customer. In Britain, the old "Proto" apparatus was the standard for so many years that new development came through government research, and now through the N.C.B.

In spite of these comments, the Safety Supply Co. who distribute the Drager BG 174 apparatus, which is almost exclusively adopted in Canadian mines, say that they would welcome competition.

It should also be remembered that demand for the BG 174 in Canada has now been largely met, so that, unless a much superior apparatus can be made available the opportunity for sales lies almost exclusively in spares and replacements.

Many people, in both government and industry, believe that the cost of spares for the BG 174 and associated equipment is excessive. There were also complaints that packaging of some items created unnecessary parts purchases. For example, certain gaskets which had to be replaced at frequent intervals were only supplied in packets along with other gaskets which were rarely needed. It is understood that the packaging complaint is receiving attention. The apparently high cost of parts is attributed to a number of factors:

a) the cost of storing and distributing
b) the monetary inflation that has taken place since the 1970's.
c) the costs of precision and the level of quality control required, to ensure that all parts can be safely used.
d) the need for 100% reliability and the limited demand for breathing apparatus means that the costs of production tend to be high due to the low level of production.

There is one aspect of standardization that does have some importance and it is that, where different types of a particular model of breathing apparatus are manufactured, then all types purchased in Canada should be of the same type. It is difficult to suggest how this can be prevented unless an import restriction is applied, and all persons and companies concerned are notified. There is one case in Canada where a railroad tunnelling contractor satisfied the safety requirements by purchasing sets of second hand, BG

174 A (American) breathing apparatus from the U.S. This is different from the usual Canadian, metric thread, BG 174. The differences are not apparent. An emergency could conceivably result due to a mix-up of parts resulting in leaky connections.

7.5.2 Approval of Apparatus

There are no set procedures in Canada for testing and approving rescue apparatus for use in Canadian mines. The U.S., German and British system of approvals is acceptable in all Provinces. During the survey, some concerns were expressed about this but at the same time, it was noted that acceptance of foreign approvals was not creating any problems. Nevertheless, the use of light alloy parts in apparatus continues to create problems in those Provinces where exposed light alloys are not acceptable in underground coal mines.

It is very possible that this rule will either prevent Canada's coal mines from taking advantage of any newly developed equipment from the U.S., where the use of light alloys is permitted, or they will have to pay high added prices for equipment specially made to suit the very small Canadian market. Since the weight of breathing apparatus is a very important factor, the use of light alloys is very attractive.

The tanks of the Scott Air pack are of light alloy metal which excludes them from use in some Canadian coal mines.

CANMET should consult with representatives of Provincial mine safety departments, the mining industry and manufacturers to examine the value of:

a) Issuing approvals for breathing apparatus and filter self rescuers
b) seeking an acceptable method of rendering "off-the-shelf" apparatus with light alloy parts, acceptable to Canadian coal

mines. To be "acceptable" may only require the cladding of tanks, in say a plastic fabric, or some other light weight material.

The use of zinc spraying of light alloy parts is not always a satisfactory solution. The zinc coating may be removed by constant handling or by scratching and scraping during use. Such is the case for protective covers of breathing bags and the tanks of compressed air breathing apparatus.

Some Provinces (for example, British Columbia) would require an exemption from the Chief Inspector to use a zinc sprayed component. See B.C. Coal Mines Regulation Act, Section 2, 28; R133 (2).

7.6 EQUIPMENT USED FOR UNDERGROUND EMERGENCIES

The storage of drinking water and dehydrated foods for trapped miners is an area that has received little attention. This is probably because, fortunately, the entrapment of miners for extended periods of time is very rare. However, in the U.S. two developments have taken place. One is to drill holes from the surface to intercept the galleries where men are trapped. Food and drink have been passed through a borehole to sustain the miners until they could be released. There is also equipment operated by the U.S. Mine Emergency Organization which can be moved to an emergency site (Section 4.6 of this report) to drill a hole using 28½ inch diameter bits to reach the trapped miners. The miners are raised to safety through the borehole in a special, one man, escape capsule. In conjunction with the drill, another system now being used in the U.S., is a means for locating trapped miners using a sensitive seismic recorder. See Appendix VII, Section 7.7, for more information. Unfortunately these techniques might have limited application in Canada because the mines are usually either too deep, or the surface terrain too steep and rugged to mount the drills. Further investigation as to its applicability to Canadian conditions should be undertaken. In cases where shaft hoists from surface are for some reason inoperable, portable emergency hoists have been designed to raise men from the shaft. A Canadian Company produces emergency hoists which can operate to considerable depths (See Appendix VII, Section 7.7). One of these hoists is currently on standby in Saskatchewan, and there are two in Quebec.

The Saskatchewan hoist is truck mounted but requires a concrete pad near the shaft to function. The equipment uses a "simplex" controller, is hydraulic powered by diesel, and fitted with limit switches and speed depth-brake interlocks. It operates to depths of 3,400 ft. Poland has such emergency hoisting equipment. The Hyse 1.25, produced in Sweden and the Polish B1500A, are used for emergency hoisting for depths up to 1000 m. Portable, large diameter drilling equipment, for example, the EW-1200 operated by oil and gas enterprises is used in conjunction with the emergency hoisting equipment.

7.7 UNDERGROUND REFUGE STATIONS

Refuge stations are used in the hardrock mines of Ontario, Manitoba, Quebec and British Columbia. Refuge stations are equipped with first aid supplies and other survival aids, but not food. In many hardrock mines (i.e. Ontario and Manitoba) filter type self rescuers are not used due to problems of maintenance. Instead the OXY-SR 30 and 45 self rescuers are kept in the refuge stations. The use of refuge stations in coal mines is not practiced because of the difficulty in constructing a sealed chamber. However, in cases where the mines extend for a great distance from the surface opening, such as the projected undersea workings of the Cape Breton Coal mines, construction of a chamber in the rock above the seam should be considered. The Sullivan Mine in B.C. have conducted experiments on the construction of Refuge Stations and have drawn up reliable construction specifications. The cost for an adequate station has been found to be in the region of $75,000 - 80,000. (See Appendix VII, Section 7.8)

7.8 EQUIPMENT AIDS FOR UNDERGROUND TEAMS

7.8.1 Communication

Voice communication between team members under oxygen, and the fresh air base is possible using an intrinsically safe, sound powered, telephone system. This allows communication to be established by tapping a face mask microphone into a light telephone line to speak. Responses are transmitted through 7 kg loudspeakers, one at the fresh air base and one at the rescue team working area. Obviously, this is not ideal for travelling as it adds a little more to the equipment which must be carried by the team. See Appendix IV, Section 4.4; Mr. Franz-Josef Kock's paper presented at the International Symposium on Crisis Management.

This equipment is reported to be widely used in West Germany and has been recently introduced into Australia. In the U.S., face mask mounted microphone/earphones and a small transmitter/receiver have been used to facilitate voice communication between team members. This equipment is not widely used and is not approved for coal mine use. Other types of equipment are being tested by the U.S.B.M. (See Appendix VII, Section 7.9). This new equipment may have the potential to provide some form of signalling between the rescue team and the surface.

7.8.2 Lights

The use of high intensity lights are being used in U.S. hardrock mines. They have proved very valuable in heavy smoke when used with an orange filter. The lights are not approved for use in coal mines.

Another development is the chemical light stick. This is a plastic, translucent, tube filled with two chemicals. One chemical is contained inside a vial which is broken by shaking the tube. The two chemicals mix, and produce a glowing light that will last up to 6 or 7 hours. Some thought might be given to the use of these light sticks as route markers in a smokey atmosphere.

7.8.3 Hand Held Instruments

A hand held, continuous readout carbon monoxide gas detector is now available. Its capacity is limited to 500 ppm which places some limitation on its application. It is much quicker to use than the glass tube and rubber bulb method. The detector should prove useful in locating the source of a spontaneous heating problems. In the U.K. regulations require that canaries or similar birds be placed at fresh air bases to provide a constant monitoring for carbon monoxide. Canada does not have regulations governing the monitoring of CO at the fresh air base but this new instrument can readily provide a means for doing this.

In Poland and Germany, rescue rules limit the exposure of teams to high temperatures. In order to comply with these regulations, it is necessary to take temperature readings. A digital thermometer has been developed which emits an audio warning when the maximum, permitted safe temperature has been reached.

7.8.4 Mine Atmosphere Analysis

Equipment is available to make on-the-spot analyses of the mine atmosphere. The samples are drawn through tube bundles which extend from the fresh air base to the sampling site where the analysis equipment is located. This equipment is used to monitor the atmosphere during fires or when seals are being opened in preparation for recovering a mine area.

Equipment Review

MSA (Britain) Ltd, East Shawhead, Coatbridge, Lanarkshire ML5 4TD

EMCOR carbon monoxide detector now approved for underground use

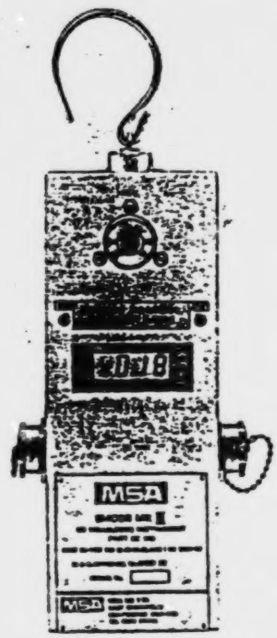
The EMCOR Carbon Monoxide Detecting and Monitoring System was developed by the NCB at their East Midlands Laboratory using MSA's Electrochemical CO sensor. Based on this initial NCB development work MSA are now manufacturing a reliable and robust instrument whose unique design enables it to be used in any of three ways:

(1) as a hand-held instrument to replace stain-type detector tubes
(2) as a local alarm, to warn of concentrations of carbon monoxide above a preset level
(3) as a continuous monitor linked to an underground data transmission system to give an immediate indication at the surface of fire or spontaneous combustion.

The EMCOR is powered by two Duracell Mk 1800 dry cells which give more than three months' continuous operation.

There is a highly visible liquid crystal display which is unaffected by an internal range switch giving a 0-4-2V analogue output for either a 0-50 ppm or 0-500 ppm range via an external socket. The selected analogue output is indicated by one of two LED lamps. A second external socket can be connected to a 'Mine Flash' visual alarm which flashes synchromatically with the appropriate LED on the front panel of the instrument. Normal operation is indicated by the LED flashing once every fifteen seconds. If a preset alarm level is exceeded the frequency of the flash increases to once every second.

Prototype units made at East Midlands Regional Laboratory have undergone field trials in several NCB areas including South Midlands, Western, North Nottinghamshire, Scottish and South Nottinghamshire. In all of these trials the results obtained by EMCOR have generally compared well with those obtained by other methods such as underground infrared analysis, surface tube bundle systems, laboratory analysers, etc. EMCOR has now been fully approved to BS1259.58 for underground use and is in regular production at MSA, extending the range of gas detection equipment specifically designed by MSA for the mining industry.



The versatile EMCOR carbon monoxide detector

This can be a very critical operation and it requires that concentration of noxious gases be identified very quickly. The time usually taken for a sample to reach a surface analysis through a tube bundle may be too long to be of practical benefit. Once the analysis is done the information has to be relayed back to the team and/or fresh air base to be of any value to anyone. In Australia and in Europe, fresh air base gas analysis equipment is used. Also, in N.S.W., Australia, a special auxilliary team is used to install the tube bundle and collect on site samples, leaving the main team free for other tasks.

7.8.5 The Flame Safety Lamp

It is customary for underground teams to carry a flame safety lamp. The lamp's main purpose is to indicate either the presence of methane or a lowering of the oxygen content. A hand held instrument is now available in North America for measuring both methane (CH_4) and oxygen (O_2) It has therefore, the potential to replace the flame lamp. This instrument has a pre-set audio alarm.

The flame lamp has a restricted range of use:

CH_4: Min. 1 1/4% - lowest reading by eye (approx.)
Max. 5% - flame goes out and no more readings can then be taken.

O_2: Min. 16% - flame goes out and no more readings can be taken.
Max. - N/A

Within these limits, the flame lamp is very reliable. It is this reliability, compared to that of instruments, which prolongs its use. As single instruments increase in reliability and accuracy for measuring O_2 and CH_4, the flame lamp will become less popular.

The flame lamp cannot be used in irrespirable atmospheres, regardless of whether there is dense smoke or not.

The flame lamp is useful for "on-the-spot" monitoring of atmosphere when ventilation is being restored to the mine sections.

7.8.6 Special Clothing

Underground rescue teams are employed in a variety of environmental conditions. Hard physical effort in hot and humid conditions, fighting fires in very hot conditions, working in very cold intake tunnels and entries under winter conditions are illustrative examples of such environmental conditions. Surface teams can also be exposed to very cold temperatures and high winds while working on exposed steel structures or while handling fire hoses.

Although the comfort of rescue personnel can be improved by wearing appropriate clothing, this area (clothing) has not received much attention in Canada. However, clothing for warmth, for firefighting, and high temperature resistant - flame retardent clothing to protect against radiant heat (aluminized suits), are all available in Canada. In Germany, the use of protective clothing is standard.

Following the fatal burning of an entire German mine rescue team in 1965, improved fire resistant garments were introduced as standard equipment. This was supplemented by protective hoods and garments where explosive conditions prevail.

7.9 EQUIPMENT USED BY SURFACE MINE RESCUE

Examples of surface mine rescue equipment and the minimum requirements for surface mines in B.C. are given on the following page. The main emphasis is on firefighting, rescue from crashed or overturned vehicles and rescue from high places.

B. C. MINISTRY OF MINES

MINIMUM REQUIREMENTS FOR SURFACE MINE RESCUE -

6 - 3/4" x 125' manilla rope)
6 - ½" x 125' manilla rope) or the equivalent in S. W. L. in nylon
6 - ½" x 50' manilla lashing)

First Aid equipment includes #2 Kit

4 - 5/8" x 8' wire rope slings c/w shackles

2 - 6" snatch blocks

2 - 10 lb sledge hammers

4 spade shovels

6 picks

6 snow shovels

6 - 1 1/8" x 4' steel pins

2 axes

2 saws

2 hacksaws c/w blades

2 stretchers

8 blankets

6 pr. gloves and safety glasses

6 safety belts

6 radar lamps

2 - 5 lb. extinguishers

1 hot stick

2 hot gloves

1 pr. rubber boots

2 air paks (pref. 2 c/w spare bottles)

1 multi-gas detector

1 safety lamp

2 crow bars

2 pinch bars

Assorted wrenches and hand tools

2 rescue drums

12 - 1/4" x 8' min. avalanche probes

100' avalanche cord

1 O_2 therapy unit

Rapelling equipment

1 wooden extension ladder

1 swede saw

7.10 SPECIAL CANADIAN CONDITIONS

Comment has already been made on some of the Canadian conditions, such as remote mining areas, and the effect that remoteness has on their mine rescue arrangements. The remote location of some mines is the principal reason that the British, Aerolox, liquid oxygen apparatus, was not accepted in Canada. Several difficulties arise from using liquid oxygen. First, there are few mines where a ready supply of liquid oxygen can be guaranteed; second, there are no flasks suitable for carrying and storing liquid oxygen for extended periods (i.e. weeks or months) without the oxygen being lost through gasification; third, the transportation of liquid oxygen by air is virtually ruled out because of M.O.T. safety rules; and fourth, the system proved too expensive.

One problem in Canada that had to be considered was the heavy road traffic in the Sudbury area. At times there were minor delays even though mine rescue vehicles in that area are equipped with flashing red lights.

Another problem in Canada is winter weather conditions, such as icy roads, blizzards, and blowing snow. Unfortunately, these conditions can affect air as well as road transport. It is recommended that all Provinces - and some have already done this - make arrangements with Provincial Emergency Services, Military and Police to expediate the movement of equipment, supplies and men to mine emergencies.

Heaters on the main fans are normally required during winter in Canadian mines. In emergency, the heaters may have to be turned off. This might, in some situations, cause problems such as the freezing up fire fighting water supply.

The effect of long distances, extensive workings and steep grades, raises, inclined shafts and slopes are other items that should be assessed. Based on actual trials with fully equipped mine rescue teams, the rates of travel that can be sustained on a variety of gradients can be recorded. From this information, charts can be made to aid management when planning recovery work.

Where mines are extensive and where long steep gradients must be travelled, it is normal to have facilities for transporting miners to locations close to their working places. In most cases, there will be a means of transporting supplies in the mine. A rescue team can use the same facilities, providing they are still operable. Mr. Kock of the Essen Rescue Centre in Germany notes that, as the size of underground mines increases, travel on foot becomes increasingly difficult and time consuming. He stresses that man riding facilities should be installed for steep slopes and at intake airways, for emergency use. Floor mounted track vehicles, rail bicycles and monorail suspended vehicles are also said to be useful. (See Appendix IV Section 4.4. Part B, Mr. Kocks presentation at the Symposium on Crisis Management, Sydney, N.S. Oct. 1982).

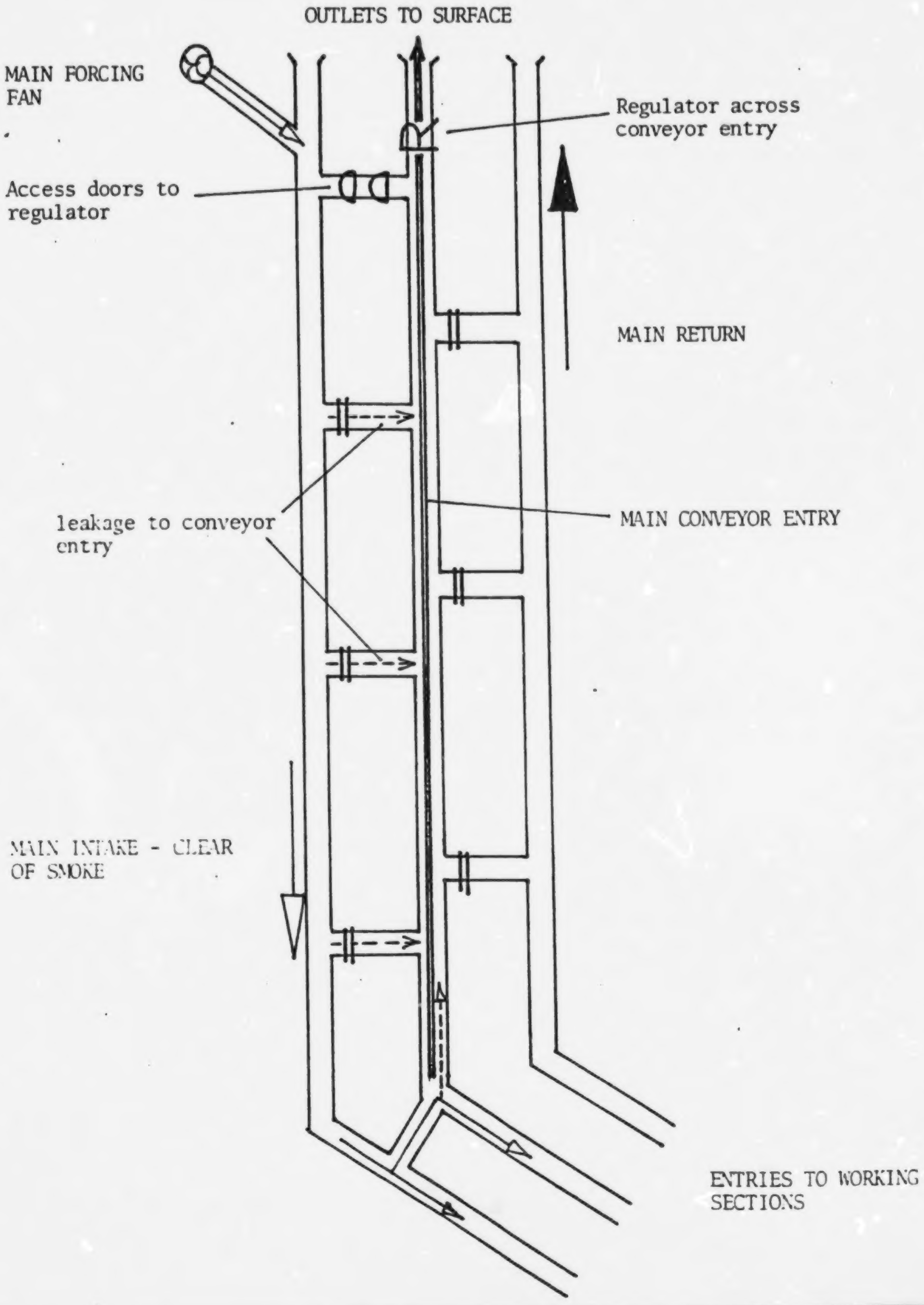
Once a mine roadway has been examined and cleared of smoke and the man riding equipment has been found safe to operate, the existing facilities can be used. In conditions of heavy smoke and dust and/or greatly reduced oxygen, vehicles powered by diesel cannot be considered. Battery powered vehicles with sufficient capacity to carry a team are a suitable means of transport, provided the gradients are not too severe.

Care must be taken to ensure that the vehicles are reliable and that they do not encourage a team to extend itself, only to find that the vehicle has developed a fault can't make it back to the fresh air base.

Rope hauled transportation on rails is probably more reliable than most forms of transport. However, before it can be used, the track must be declared safe. This also applies to the return pulleys and ropes for endless and main and tail rope systems. Rope haulage offers the best possibilities for use in smoke.

Access to underground mines by rescue teams and a means of transportation underground during emergencies, should perhaps be given more consideration at the design stages of a mine. This particular aspect was dealt with in a report: "Appraisal of Coal Mine Ventilation" (Section 11.5.5) prepared for CANMET in July 1982 by Norwest Resource Consultants, in association with Dames and Moore. It was suggested that main trunk conveyors (noted as being a fire hazard) be located in roadways that are ventilated by return air. Where forcing main fans are used, a portion of the intake air at the inby end of the main conveyor entry can be allowed to flow along the conveyor line to the portal or return shaft. The amount which flows through can be controlled by reulators at the outby end. In this way, the possibility of smoke from a conveyor fire entering the intake airway is reduced (leakage will be from intake to return). Access to the fire can be gained more easily and safely. The siting of the regulator at the outby end means that the supply of air to the fire can be controlled with a minimum of travelling. An illustration is given in Figure 7.1.

FIG. 7.1
VENTILATION OF MAIN CONVEYOR ENTRY


OUTLETS TO SURFACE
MAIN FORCING FAN
Regulator across conveyor entry
Access doors to regulator
MAIN RETURN
leakage to conveyor entry
MAIN CONVEYOR ENTRY
MAIN INTAKE - CLEAR OF SMOKE
ENTRIES TO WORKING SECTIONS

SECTION 8
EMERGENCY PROCEDURES

8.1 PRE-PREPARATION OF EMERGENCY PROCEDURES

The preparation of an emergency plan is the basis for a well organized rescue and recovery operation. It is management's responsibility to set up the plan and, in most Provinces, it is the Inspectorate's job to ensure that the plan is satisfactory and meets with Provincial standards.

This aspect will not be discussed in great detail because it has more to do with crisis management which was adequately dealt with in the 1982 "Crisis Management Symposium", in Nova Scotia.

The emergency plan must provide for the mobilization of rescue teams and should provide priority for the transportation and hoisting of underground rescue team members. Agreements necessary to permit teams to be brought in from other Provinces and possibly from the U.S. should also be in place. This could involve obtaining permission for them to leave their district and arranging agreements to pay for travel, accommodation, insurance and salaries.

8.2 WARNING DEVICES

When an emergency is reported, the person reporting it must identify himself. The emergency procedures should go immediately into action, not waiting for prior consultation with management.

The warning device used in hardrock mines and in other mines such as asbestos and salt, is the "stench" warning. The warning is given by injecting **ethyl mercaptan** into both the ventilation and the compressed air lines. A new stench warning substance, **tetrahydrothiophene** is being used in some mines. It is less nauseating and is not absorbed by the metal compressed air pipelines. The use of the stench warning has not been favoured in coal mines, partly because of the absence of compressed air. Tests should be carried out at coal mines to determine just how effective the stench warning might prove to be. In other mines such as salt, gypsum, and potash, the roadways are large and the ventilation air speeds too slow for the stench warning to be effective and alternate methods are necessary. In the potash mines, vehicles equipped with a siren and a red flashing light are sometimes used to spread the alarm and to collect the work crews. In mines where a trunk conveyor system is in use, a distinctive emergency signal can perhaps be given by means of pre-start up audio warning devices on the conveyor.

8.3 DIRECTION OF RECOVERY OPERATIONS

It is accepted, both in Canada and elsewhere, that the direction of rescue operations is the responsibility of management and that a person from the management staff should act as sole director.

Since early 1982 reponsibility for rescue operations in Germay has been reassigned, from the Mines Inspectorate to the mine management. An emergency management team consists of a mine inspector, management staff and the mine rescue centre personnel. These people assist the mine manager with his responsibilities.

In Poland, the Director of the rescue operation (referred to as the "Rescue Action Leader") is the mine manager. There is also an Underground Rescue Leader and a person in charge of the fresh-air base.

In Britain, mine management have always been responsible for directing rescue operations, usually through the mine manager.

It is very important that management fully understands mine rescue procedures. Rescue and recovery operations may suffer if mine management does not know how best to utilise the rescue teams at their disposal nor appreciate their limitations. This important aspect of mining is believed to be receiving little or no attention in the Universities which teach Canada's future mining engineers. In Europe, the organization and management of rescue and recovery operations is part of a mining engineer's education.

Although only one person is responsible for directing the rescue operation, this does not imply that he should work single handed. An emergency is a very tense time during which quick but careful decisions must be made. The Director of Operations should consult with a team of expert advisors, which should include not only his own technical staff but also the Mine Inspectors or Engineers and Government Mine Rescue Station Superintendents.

The selection of persons to be in charge of a fresh air base should take account of the following qualities:

a) He should be a trained rescue worker, fully conversant with breathing apparatus, rescue equipment and recovery procedures.
b) He should be a good communicator with good hearing and clear speech. He will need to have good writing skills that enable him to keep accurate and concise records.
c) He should be conversant with various types of monitoring, instruments and should have a good knowledge of ventilation and gases, first aid and general mining techniques.
d) He should be a person of calm disposition, with good organizational and supervising skills.

Because an emergency involving rescue teams is a rare event, mine officials who have had previous experience at directing an emergency, or who have previously been in charge of a fresh air base are the people most qualified to assume leadership a second time. However, at a fresh air base there should be an age limit of perhaps not over 55 years.

8.4 RESCUE OPERATIONS, RECORD OF EVENTS

When "Emergency Procedures" are established, it is essential that certain people be designated to record in detail, every step of the operation. They should note the time of all activities, and the instructions given to rescue teams as well as preserving all reports. This detailed information is essential for effective control of the recovery operation. The services of a shorthand typist must be provided for in the Emergency Procedures Plan.

Accurate records should be kept of all discussions and the rationale which supported the decisions made by the manager on the advice of his team of experts. In Europe and parts of the U.S., keeping records is given great importance. In the Kellogg region of Idaho all meetings and discussions are recorded on tapes.

All instructions from the manager must be systematically recorded, noting the time at which they were given, who received them and at what time they were implemented. In cases where difficult and controversial decisions must be made, the Mine Manager should consult his advisors. When he issues his written instructions, they should be endorsed by the signatures of his advisors including those of the Inspectors and Engineers of the Provincial Mines Departments. In Europe, though it is the responsibility of the mine manager to direct the operation and issue instructions, the reponsibility for arriving at difficult decisions is shared jointly by his advisors. In this way, the stress and possible recrimination, is not made the burden of one individual.

It is very important that mine rescue teams learn and improve from past experience. Bad experiences and mistakes, which are often only apparent after the event, should not be hidden. Recovery operations should always be the subject of at least an "in-house" assessment of all that happened. In many countries, the records of such events are made available for the benefit of others. Canadian practice in this respect varies. Whether the details of the incident are made known or not, often depends on whether a loss of life was involved. This can perhaps be regarded as a weakness in Canadian methods.

SECTION 9
RESEARCH AND DEVELOPMENTS

9.1 INTRODUCTION

During the course of this survey, two important points emerged in relation to research and development:

a) Almost everyone considered that communications should be given a high priority in research and development.
b) No suggestions for improvements or new ideas for development, were put forward.

This aspect of the survey was very disappointing.

One possible explanation for this lack of ideas is that the people connected with mine rescue, such as Mine Inspectors, Mine Managers and Chief Inspectors have many other duties which demand a substantial amount of time. Also, the educational background, training and daily tasks of instructors and team members are not those which naturally lead to ideas and concepts for research. On the other hand, they do produce innovative ideas to make good use of their equipment.

For example, the problem of spontaneous heating of the sulfide ore at the Sullivan Mine in B.C. resulted in the mine's technical staff designing special, mine-car size, mobile fire stations. These mobile stations contain all the equipment required to attack the fires. This includes, breathing apparatus (Scott air paks), tools, and firefighting equipment. The cars are held ready for immediate use at a surface station and, as an emergency arises, they are quickly transported to strategic locations in the mine with minimum delay.

9.2 AREAS OF RESEARCH AND DEVELOPMENT

The following remarks concerning areas of research and development are based mainly on what is being done in Europe and the U.S.A. Most of the European ideas were brought to the attention of the writers by Mr. B. Stewart of Canmet following his discussions with participants in the "International Crisis Management Symposium" in Sydney, N.S., October, 1982. However, the writers have added their comments and observations hoping to stimulate discussion among Canadian mine rescue people.

9.2.1 Training

The development of training manuals and the physical fitness of Canadian mine rescue workers have been discussed earlier in this report.

Training methods have changed little since the early days of mine rescue, except for the recent introduction of the modular form of training manual. Little or no attention has been given in Canada to the development of didactic aids such films, video tapes, and models. Models, for example, could be an excellent aid for instructors dealing with the following items:

a) methods of construction and breaching of seals.
b) systematic recovery methods
c) control of ventilation
d) search and reconnaissance procedures
e) dealing with fires

9.2.2 Breathing Apparatus

Little information was available regarding the development of the British or any other, new type of breathing apparatus. There were however improvements underway for existing apparatus and a "plus two hour" filter type, self rescuer with heat exchanger. (figure following) is offered by Drager.

Self-rescuer FSR 850 from Dräger (West Germany) protects against carbon monoxide and combustion gases for close to three hours. Incoming air is cleaned of solid particles, then dried and decontaminated in the CO catalyst. A heat exchanger in the mouthpiece dissipates much of the heat generated during CO combustion into the environment. The self-rescuer weighs 1.060 grams and is 135 millimeters high.
CIRCLE NO. 261

9.2.3 Instrumentation

Instruments having digital readouts and audio warning, such as a thermometer produced in eastern Europe, are being developed. These are extremely useful in conditions of poor visibility (ie. heavy smoke).

Gas analyzers have been used in Canada to monitor mine atmospheres in conjunction with the tube bundle system, but have not been used in connection with mine rescue work. Australia is currently using quasi-real-time gas analysis equipment, as an aid to mine rescue. The use of instruments to analyze gases and to predict trends or changes in the mine atmosphere behind fire seals, is a valuable safety aid. Although this technology is presently available, it is not being widely used in Canada.

9.2.4 Transportation

The difficulties in transporting rescue teams were identified in an earlier section of this report. The main problems associated with transportation underground are, visability and where track is used, the uncertainty as to whether track and hauling arrangements are undamaged. The haulage system has to be examined and found in safe condition before it can be used by the rescue teams.

Where smoke is the major problem and transportation is by rope haulage, it should be possible to develop a sealed pressurized man-riding car which would have its own air supply from tanks carried on the car. This would enable the rescue team to travel in a "mobile fresh air base". They would then not need to use the oxygen from their apparatus until they were ready to leave the car at the inbye end.

The provision of air tanks and breathing masks for the drivers of locomotives and diesel vehicles could permit the operation of such equipment to move people out of the mine during an emergency. While the equipment for the above activity is presently available, the method is not being practiced in Canada.

9.2.5 Protective Clothing

Although protective clothing, is generally available, no special efforts are being made in Canada to either use or improve firefighting apparel. Special equipment for air cooling a person's body and the inside of the protective clothing is now available but no rescue teams in Canada reported using it. Effective, heat resistant clothing could be very useful to underground mine rescue teams.

9.2.6 Firefighting

The use of foam generators as effective aids in fire fighting underground, is well established. Their use, apparently, is not widespread in coal mines.

The use of inert gas (nitrogen) in quenching fires is being developed in Germany and to some extent in Great Britain.

The cooling effect of nitrogen is advantageous but, to be effective, it must be introduced in very large quantities in order to reduce the oxygen content in a fire area below the level at which burning or spontaneous heating can take place. This also renders the atmosphere non-explosive thus increasing the safety of rescue workers.

Some of the difficulties related to the use of inert gas are as follows:

a) It is cheap to produce but expensive to keep stored in the necessary quantity.
b) It is difficult to transport underground in large quantities.
c) It cannot be considered as readily available to many of Canada's mines.

One of the limitations on the use of inert gases was referred to by H. Price B.Sc., in 1945 in his booklet "Notes on Spontaneous Combustion in Coal Mines". He said that "The flooding of wastes with inert gases would be an excellent specific against oxidation providing that the inert gases could be retained in situ" and" the inert gas would be subject to the same laws of motion under pressure as was the air and would eventually pass out of the goaf leaving the crevices and voids still open for the re-entry of air". Mr. Price's comments are in reference to the control of spontaneous heating but his comments are also pertinent to the use of inert gas for underground fire fighting.

The above considerations probably explain why the developments using nitrogen are mainly confined to fires on coal mine mechanized longwalls and in coal development headings.

The trend towards driving long single coal headings to develop longwall panels means that the conventional methods of recovering dual headings, by re-establishing the ventilation in stages, cannot be used. However, recovery of the heading can be accomplished by flooding it with nitrogen. The quantity of nitrogen needed to do this would be limited to the volume of the heading so that handling costs should not be prohibitive.

Nitrogen has also been used to extinguish fire on a longwall face. In this case much more nitrogen is needed, depending on the height of the seam. However, when one considers the high capital value of a mechanized longwall face, to say nothing of the loss of reserves and the cost of re-installing equipment on a replacement face, the problems of supplying so much nitrogen can perhaps be justified. Its use is specially attractive because it would not harm electrical and hydraulic equipment.

Further evaluation of the use of nitrogen, with particular reference to the Cape Breton coal mines where longwalls are in use, is recommended.

9.2.7 Location and Retrieval of Miners

Reference has already been made to the U.S. developments for locating trapped miners using the loop antenna powered from the cap lamp battery. (See Appendix VII Section 7.9 "Trapped Miner Transmission") and the use of Geophones to pick up sound signals from a miner striking a roof bolt with a hammer (see Appendix VII Section 7.7, "Equipment Used for Underground Emergencies".) Section 7.6 of Appendix VII mentions drilling from the surface to reach trapped miners, permitting food and air to be supplied through the borehole. Miners can also be retrieved by raising them through a large diameter boreholes, hoisting them up inside a capsule.

Canada has no apparatus of this type ready for an emergency and has not developed the experience to conduct such a rescue. A borehole trial rescue should be conducted in Canada to obtain the experience and develop the necessary organization.

A recent Polish development has produced cap lamp batteries equipped with an encapsulated transmitter which emits a singal at a unique frequency. The rescue team carries a directional receiver which allows them to "home" onto the cap lamp. The unique signal frequency of each transmitter identifies the cap lamp number.

Some of the rescue personnel interviewed referred to the possible use of infra-red heat detectors to locate injured miners in heavy smoke conditions.

Reference has already been made to the use of emergency hoisting when the regular hoist is inoperative. In Poland, a "Rescue Sleeve" is being developed through which persons trapped in an arrested shaft conveyance can safely reach the shaft ladder compartment ("The Mining Engineer" May 1983 p. 605, see following page).

9.2.8 Communications

Communication was said to be the most important area for research and development. Ideally communication should be established between the surface command base, the fresh air base and each team member. At present this is not possible, though it is usual to establish telephone communications between the surface and the fresh air base.

The use of sound powered microphones is already developed but present systems require the speakers and microphones to be electrically connected to a common conductor system. This restricts the team's freedom of movement. Nevertheless, the system can be considered adequate for tasks such as installing tube bundles. Consideration should be given to fabricating the tube bundles with conductors included as part of the cluster of tubes. This would allow the installation of tubes and communciations lines to be done at the same time.

The system with the most potential is the single line conductor, radio communication. This equipment is already in use in some mines as the main mine communication system. It is particularly useful where the drivers of locomotives and diesel vehicles need to be kept in constant voice communication. The main advantage of this sytem is that it is not necessary to have the microphone/earphone physically connected to a line. This means

Translated Review

Evacuation of men trapped in a shaft cage using a 'Rescue-Sleeve', by M. Odrobina and A. Rusin.

Abridged translation of an article published in the Polish Journal of Mining Engineers and Technicians *(Wiadomości Górncze)*, 1982, Vol. 33, No. 6.

In the mining industry the winding cage may on occasion be suddenly arrested between the winding guides, or held back due to a breakdown of the power supply to the winding engine. In these circumstances, it is often necessary to evacuate the men trapped in the cage, and lead them safely to the ladder compartment of the shaft. The method by which the trapped men can be released and brought safely to the shaft ladder compartment, however, depends mainly on the position and distance of the arrested cage from the ladder compartment.

In the event that the cage with the men trapped inside, is adjacent to the ladder compartment, the evacuation of the men does not present any great difficulty. Since in this case, the mine rescue team can easily descend from the surface by ladders to the arrested cage dismantle the partition between the ladder compartment and the cage, climb on top of the cage and gain access by opening the hatch in the cage top. Once inside, the team can render first-aid to the trapped men and then lead them safely to the ladder compartment of the shaft and up to the surface.

Evacuation of men from a winding cage arrested at some distance from the ladder compartment, complicates the whole rescue action considerably. One possibility is to use specially adapted rescue-platforms fixed to the shaft buntons, though in practice these have proved to be both cumbersome and dangerous, especially when the evacuation must cope with injured and unconscious men or those suffering from shock. Moreover, construction of special platforms is inevitably time consuming. Consequently, after an extensive search for the most suitable rescue method, it was finally decided that the specially adapted 'rescue-sack' used by the fire-brigade would be a suitable solution. An elaboration of this concept was the so-called 'rescue-sleeve', inside which a safety line is stretched, with one end secured to the hand rail of the cage and the other to the ladder in the ladder compartment of the shaft, see **Fig 1.**

The cardinal merit of this solution, which was later officially named the 'mining rescue-sleeve', is the possibility of leading out trapped men from an arrested cage to the ladder compartment of the shaft. In addition, the rescue-sleeve is very light, simple and safe to use, as well as being easy to transport and assemble. Prior to installation of the rescue-sleeve between the arrested cage and the ladder compartment, the following preparations should be made: an 800 mm dia. escape-hatch must be cut out from the side wall of the arrested cage, equalling the circumference of the rescue-sleeve, i.e. 800 mm in diameter. During normal winding operations, the escape-hatch should be plugged from inside the cage by a steel plate screwed to the cage structure.

For multi-deck cages, the hatch should be cut out from the top deck of the cage. Furthermore, one man-hole should be cut out in the floor of each deck to allow men to pass from one deck to another. The actual position of the hatch in the side of the arrested cage depends on the technical details of the cage's construction; it must in no way interfere with the structural elements and capacity of the cage. Another consideration to be taken into account, is whether or not the winding installation is equipped with a balance rope.

The rescue-sleeve consisting of an 800 mm dia. tube made of rot-resistant canvas, is approximately 3·50 m long with steel rings at either end. for the rescue procedure, the sleeve is positioned between the ladder compartment of the shaft and the arrested cage, and secured by screwing the steel rings to the cage and to the partition of the ladder compartment. Inside the rescue-sleeve, a safety line facilitates swift evacuation of men from the cage by enabling them to fasten their safety belts to the line using special holders.

Usual practice is to keep the rescue-sleeve, with all the necessary accessories, in a special container stored in the top part of the winding cage, ready for any emergency. All elements of the rescue equipment must be made of good quality materials, and manufactured according to calculated strength requirements; whilst the actual transfer of men from the arrested cage should be performed according to the detailed instructions.

This method of evacuation was carefully examined and tested by specialists at the experimental colliery—Barbara-Chorzów, in Upper Silesia, Poland. The tests included minute examination of all components and accessories of the rescue-sleeve, as well as the measurement of the the following operations: delivery of the sleeve to the arrested cage, its assembly and positioning, etc. Movements of the rescue team were also rehearsed during mock evacuation attempts, which on average lasted only about 15 minutes, thus confirming full suitability of this rescue method. Incidentally, all fastening devices are fabricated with a safety factor of 6.

This method, together with the rescue equipment, has been accepted by the Polish Mining Authorities and recommended for use in any mine shaft in Poland, on the basis that it offers remarkable improvements in safety and considerable cut-backs in time consumed by the entire rescue operation, especially with regard to the delivery of the equipment, its assembly and the evacuation of the men trapped inside the cage.

In addition, the new method allows:

(1) Storing points for the platform components at pit-bottom and pit-top to be eliminated.
(2) the elimination of the transport of heavy and cumbersome components within the ladder compartment of the shaft,
(3) the whole rescue attempt to be carried out in a quick, safe and convenient manner, largely due to the light weight of the rescue equipment employed.

The 'miners' rescue sleeve' is registered at the Polish Patent Office under the reference number: P-201503.

G. A. R.

Legend

1. The 5 000 mm dia. Shaft
2. Concrete Lining of the Shaft
3. Shaft Buntons—3 000 mm Apart
4. Cages—4 Decks
5. The Rescue-sleeve—800 mm dia.
6. Rescue sleeve (Droga ewckua cyjna) fixed at one End to the Ladder and at the other to the Cage Side
7. Rescue-sleeve fixed to Side of the Cage
8. Safety Line inside the Rescue-sleeve fixed to the Ladder
9. Safety Line inside the Rescue-sleeve fixed to the Cage Hand Rail

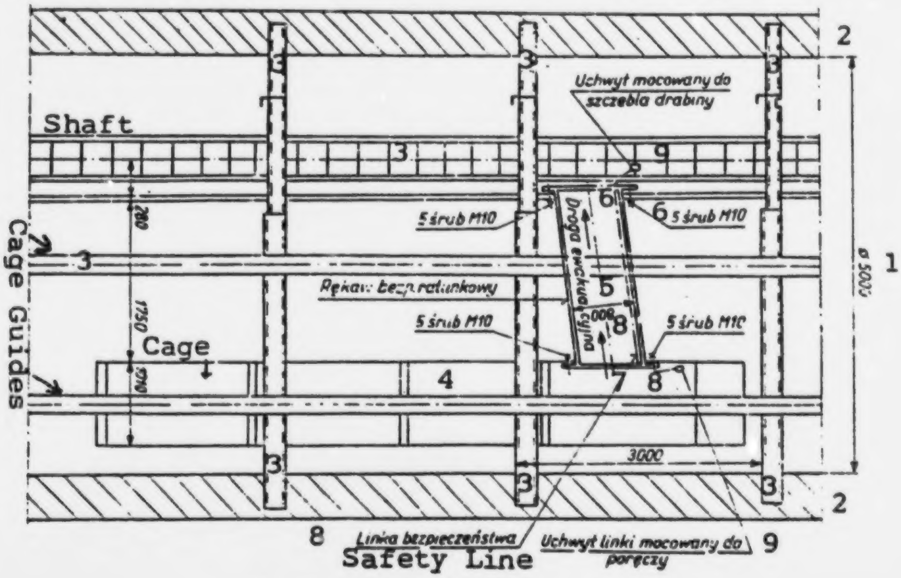


Fig. 1 Evacuation of men by means of the Rescue-sleeve

that the user has freedom of movement. It is also said that the fresh air base coordinator is able to assess the team's response to changes in conditions by noting the sounds of their respiration and voice inflections.

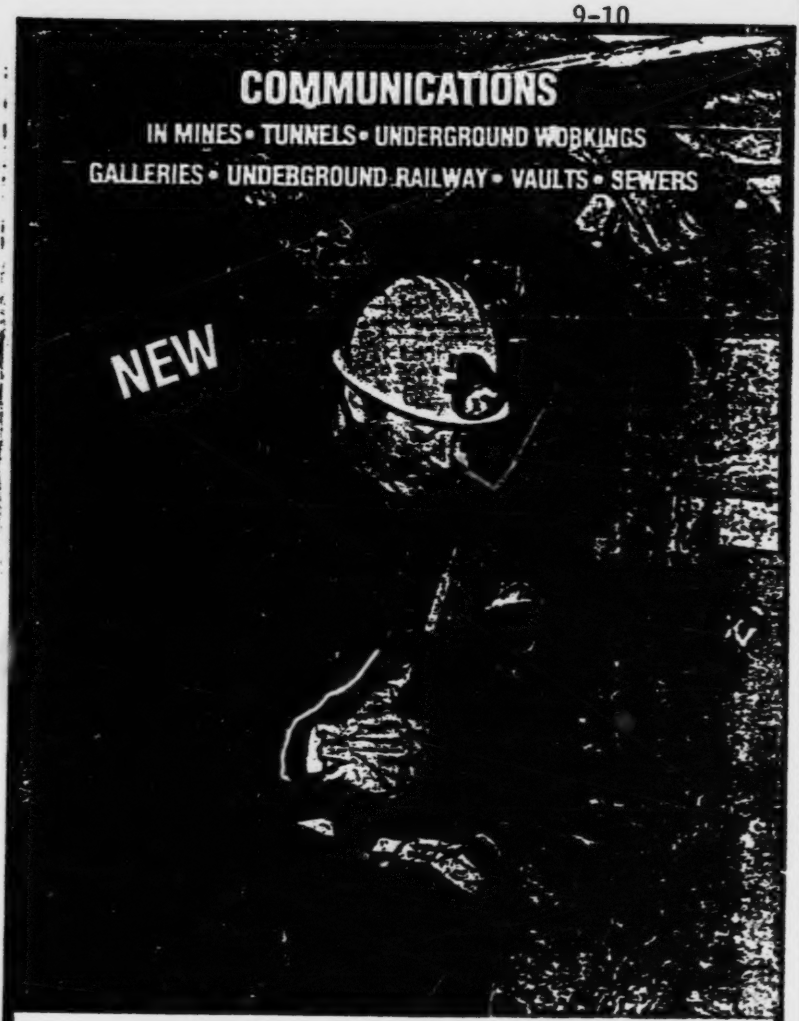
For this sytem to operate, it is necessary for the face mask of the apparatus to have a built-in microphone, earphone, and a transmitter that will transfer the signal to the single line wire. It is understood that no such face mask is yet available and its development should be given high priority. The equipment would also need to be certified as intrinsically safe.

The two technical notices on the following pages show that this technology is already well developed and in fact one of them, of French design, can use existing metallic conductors such as cables and pipes, so that the installation of a single wire conductor is not necessary.

Communications equipment for haulage is available from HRC Systems (United States). A common problem in underground mining is communication for control of haulage equipment. Carrier systems on trolleys to electric equipment has been available but practical systems to communicate with Diesel equipment have only just become available.

The Tunnel-Com from HRC works on this principle. Medium frequency (500 to 1,000 kiloHertz) radios are the safest in the underground environment where explosives are handled. They use the principal that the signal can be coupled into an ordinary non-grounded 12 gage carrier conductor to take the message anywhere the carrier goes. The transceiver must be within 3 to 5 meters (10 to 16 feet) of the carrier, because of its low power, a sufficient range for practical use in mine roadways and workings. The mobile radio can be installed with its coupling antenna on the haulage vehicle, but it is small enough to be slung from a belt.

Communication between a base station and moving vehicles underground opens the possibility for many improved operating methods. Coordinating equipment movement to stop vehicle collisions as well as communication between the driver and the end of the haulage can result in significant production efficiency increases.


COMMUNICATIONS
IN MINES • TUNNELS • UNDERGROUND WORKINGS
GALLERIES • UNDERGROUND RAILWAY • VAULTS • SEWERS
NEW

INDUCTIVE TELEPHONE SYSTEM FOR UNDERGROUND WORKINGS

- **SIMPLICITY** Inductive (contactless) transmission through any existing metal conduits : Cables, pipings, rails...
- **EFFECTIVENESS** Long communication range in non-linear galleries and in media offering high radio wave attenuation.
- **FLEXIBILITY** Portable or vehicle-borne sets and stationary sets, allowing many extensions of networks.
Sets powered by rechargeable batteries.
- **SAFETY IN GASSY MINES** Agreements for use in gassy atmosphere : CERCHAR (France) BVS (F.R.G.)

APPLICATIONS Supervisory and maintenance jobs, order links, rescue teams, mobile workings, tunnelling, excavation of galleries, underground quarries, maintenance teams in sewers, underground railways, town heating, etc...

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CIRCLE NO. 63

SECTION 10

PROPOSAL FOR A NATIONAL MINE RESCUE CENTRE

Many of the conculsions, observations and comments made in previous sections of this report indicate that Canada lacks a focal centre, where mine rescue concerns of the many different regions and mines can be brought together; where a consensus can be arrived at, a trend noted and concerted actions formulated. It is therefore suggested that all Provinces should be asked to support the setting uo of a CANMET, National Mine Rescue Centre, possibly located at an existing CANMET Laboratory.

It is envisaged that this centre would start as a small entity and develop as funds and needs become evident. Its role would be to develop the following functions:

a) It would be a repository for copies of reports from all mine rescue operations in Canada. This would be supplemented with reports form other countries, particularly the U.S., Australia, Britain and other E.E.C. countries, through their Mine Rescue Working Group.

b) It would disseminate mine rescue information in Canada.

c) It would monitor mine rescue developments worldwide.

d) If it was decided that Canadian Approvals for mine rescue equipment were required, they would be issued from this centre. This could mean, eventually, that testing facilities would be needed.

e) The centre would be a storage area for special types of equipment, such as for gas testing, and be responsible for getting it to emergency sites as required.

f) It the need was evident, a special testing, demonstrating and/or training gallery could be constructed for evaluating proto type equipment and training rescue instructors.

g) The centre could prepare training aids such as films and slide-tape programs.

h) Training seminars and National Rescue Conferences would be organized by the centre.

i) The centre would establish reciprocal agreements with foreign jurisdictions to facilitate the exchange of specialized equipment during emergencies and create lists of such equipment.

j) The centre could pursue R & D activities to further Canadian mine rescue capability.

This Centre could act as base for a National Mine Rescue Association and undertake to publish a Mine Rescue Bulletin in part fulfillment of its role to disseminate mine rescue information in Canada.

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2

SURVEY AND ASSESSMENT OF MINE RESCUE PROGRAMS

APPENDICES

NORWEST RESOURCE CONSULTANTS LTD.
JACQUES WHITFORD AND ASSOCIATES

WORK ON THIS PROJECT WAS CONDUCTED UNDER THE AUSPICES OF THE CANADA CENTRE FOR MINERAL AND ENERGY TECHNOLOGY, ENERGY, MINES AND RESOURCES, CANADA.

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APPENDIX III
LEGISLATION

SECTION 3.2.1
NOVA SCOTIA

NOVA SCOTIA LEGISLATION

1. Metalliferous Mines and Quarries Regulation Act RSNS 1967 Sections 269 - 271

2. Coal Mines Regulation Act RSNS 1967 Sections 7 - 107 - 116 inc.

3. Coal Mines (CBDC) Safety Regulations Canada Labour Code Section 23

Protective appliances.

(268) In every metallurgical plant or mill the owner or manager shall supply the workmen with:

(a) suitable appliances, masks or shields designed to protect workmen who are exposed to dust, dangerous or irritating fumes, gases, abnormal heat or molten material;

(b) life belts and lines in case it becomes necessary to rescue a workman or for use by any workman whose duties require him to work in an atmosphere which is liable to become dangerous by reason of the presence of gas;

(c) breathing apparatus and portable resuscitating apparatus of approved type, with adequate supply of oxygen and absorbent material, to be used at any operation where the nature of the work may cause air to become dangerous by reason of the presence of gas.

Maintenance of appliances.

(269) All such apparatus, appliances and equipment shall be of design approved by an inspector, maintained in good condition and kept in some secure and readily accessible place for immediate use.

Trained personnel.

(270) There shall always be on duty in each working shift such number of workmen trained in the use of such rescue apparatus as may be required by an inspector.

Appliances to be worn.

(271) The workmen shall use and wear such appliances, masks and shields, life belts and lines, breathing and rescue apparatus for their protection, and the owner or manager shall be responsible for seeing that such equipment is used.

LOCAL BOARDS FOR MINE RESCUE CERTIFICATES

Local Boards for granting certificates.

7 (1) The Minister may appoint Local Boards in such places as he deems expedient, for granting certificates of competency to the different classes of persons who have passed satisfactory examinations in subjects relating to mine rescue work and first aid to the injured.

Membership of Local Board.

(2) Each Local Board shall consist of three members as follows:

(a) the deputy inspector for the district, who shall be chairman of the Local Board, and shall as chairman sign all such certificates;

(b) a duly qualified medical practitioner;

(c) one person to be designated by the manager of the mine in which the applicant is employed, or by the managers of a group of mines where mines are grouped as provided for in Section 114.

(3) The provisions of subsections (4), (5) and (6) of Section 6 with respect to Local Boards for granting certificates of competency to coal miners and temporary permits to stationary engineers shall apply to Local Boards appointed under this Section. R. S., c. 35, s. 7.

RESCUE WORK AND FIRST AID

Qualifications of rescue station superintendent.

107 (1) No person shall be a mine rescue station superintendent unless he holds a certificate of competency as a mine examiner and a certificate of competency in mine rescue work and first aid to the injured.

Qualifications of captain.

(2) No person shall be captain of a mine rescue team unless he holds a certificate as a mine examiner.

Qualifications of team member.

(3) No person shall be a mamber of a mine rescue team unless he has practical experience underground in a mine and holds a certificate of competency in mine rescue work and first aid to the injured.

Medical examinations.

(4) No person shall be placed on a mine rescue team unless he is certified by a duly qualified medical practitioner to be physically fit for mine rescue work.

Idem.

(5) Each member of a mine rescue team shall be examined by a duly qualified medical practitioner at least once a year or at more frequent intervals in the discretion of the mine rescue station superintendent.

Age of members of rescue teams.

(6) All members of a mine rescue team shall be between the ages of twenty-one and forty years.

Spares.

(7) As soon as rescue work has been completely organized there shall be held in readiness one qualified mine rescue man fully equipped at the fresh air base to replace each mine rescue man engaged in actual rescue work. 1955, c. 20, s. 10; 1958, c. 25, s. 33.

Ambulance, etc.

108 The owner, agent or manager of every mine shall provide and keep on hand at every colliery, and ready for immediate use in case of accident, properly constructed ambulances, stretchers, splints and bandages and such other medical supplies and appliances as may be necessary for giving first aid to the injured. R. S., c. 35, s. 106.

Mine rescue apparatus.

109 (1) The owner, agent or manager of every mine shall provide and keep on hand at every colliery such a supply of oxygen breathing apparatus and other mine rescue equipment as may be required by the Minister.

(2) Such mine rescue apparatus shall be constantly maintained in an efficient and workable condition, and shall be stored or kept in a convenient place so as to be always available for immediate use.

Mine rescue corps.

110 The owner, agent or manager of every mine shall organize mine rescue corps and have certified officials who are physically fit, and such number as the inspector deems sufficient of the workmen employed in the mine trained in the use of the mine rescue apparatus required by Section 109. R. S., c. 35, s. 108.

Instructions to rescue team.

111 Instructions to any rescue team engaged in rescue work underground shall be transmitted to the team only through the senior mine rescue official underground at the time. 1955, c. 20, s. 12.

Mine rescue stations.

112 (1) The Minister may from time to time establish mine rescue stations for the purpose of supplementing, in case of need, the colliery installations of mine rescue apparatus, and also for the purpose of training persons in the use of such apparatus.

(2) In cases of emergency, such stations shall be available for the use of any trained mine rescue corps, duly qualified medical practitioners, or corps trained in the work of first aid to the injured, subject always to the order of an inspector. R. S., c. 35, s. 109.

113 The foregoing provisions of this Act with respect to mine rescue work and mine rescue apparatus shall not apply to any mine exempted by order of the Minister. 1955, c. 20, s. 13.

114 The Minister may group two or more mines belonging to the same owner for the purpose of mine rescue work and when so grouped such mines shall be deemed to be one mine within the meaning of Sections 107 to 112 inclusive. 1955, c. 20, s. 14.

Grouping of mines of different owners.

115 When the owners of two or more mines in writing,

(a) agree to provide the equipment and apparatus required by Sections 108 and 109 for use at their

Refuge chambers. **116** (1) One or more refuge stations shall be provided in each mine which can be used as refuge chambers if required.

Location. (2) The location of each station and the equipment to be kept therein shall be agreed upon by the manager and the Chief Inspector.

Exemption. (3) This Section shall not apply to a mine that is naturally wet throughout and free from inflammable gas. 1958, c. 25, s. 34.

Coal Mines (CBDC)

Safety Regulations issued under Canada Labour Code.

23. (1) The owner of every mine shall employ a mine rescue corps, which shall be under the supervision of a mine rescue station superintendent.

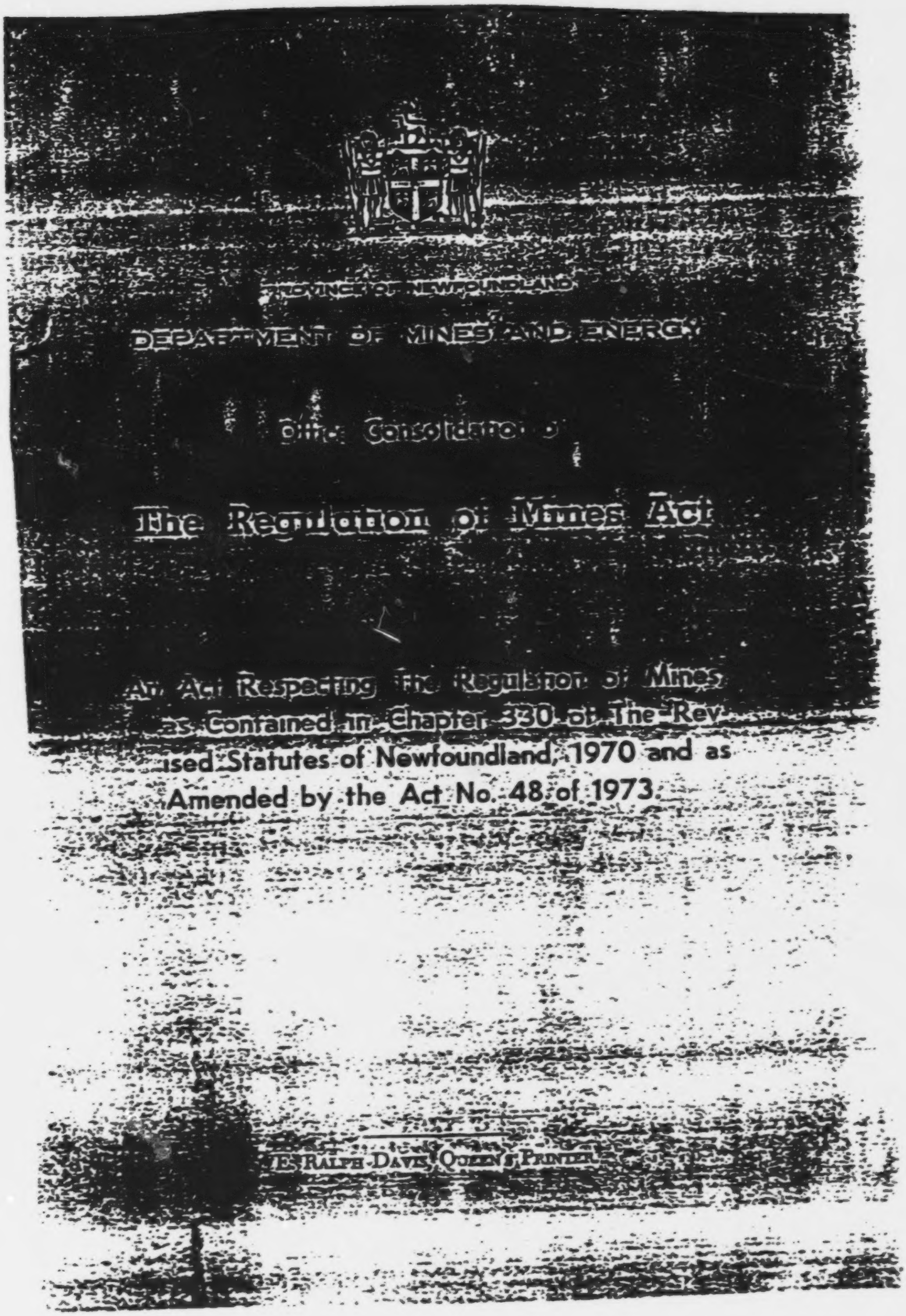
(2) A mine rescue corps shall consist of one or more mine rescue teams each of which is under the leadership of a mine rescue team captain but, subject to the approval of the Chief inspector, mine rescue teams and rescue equipment of mines within the same general area may be integrated.

(3) A mine rescue corps shall be tested and examined periodically for efficiency and competency by an inspector of mine rescue and first aid appointed under the *Mines Act* of Nova Scotia.

"(4) Emergency rescue drills shall be carried out under he direction of the safety officer or Chief Inspector within wo years after the coming into force of this subsection and t least once every two years thereafter."

SECTION 3.2.2

NEWFOUNDLAND



PROVINCE OF NEWFOUNDLAND

DEPARTMENT OF MINES AND ENERGY

Office Consolidation of

The Regulation of Mines Act

An Act Respecting the Regulation of Mines as Contained in Chapter 330 of The Revised Statutes of Newfoundland, 1970 and as Amended by the Act No. 48 of 1973.

E. RALPH DAVIS, QUEEN'S PRINTER

Mine rescue stations.

17.—(1) The Minister may cause to be established, equipped, operated and maintained, such permanent or mobile mine rescue stations as he deems necessary or advisable.

Assessment of operators

(2) To provide moneys for the establishment, equipment, operation and maintenance of all or any of the rescue stations referred to in subsection (1) or for any of those purposes, the Minister may assess the operators of all mines served by those rescue stations in susch proportion as the Minister may, in his sole discretion, determine.

Recovery of assessment.

(3) Every sum assessed against an operator by the Minister pursuant to subsection (2) is a debt due from the operator to the Crown and is recoverable on behalf of the Crown at the suit of an inspector in any court of summary jurisdiction.

Rescue stations to be in charge of officer of Department

(4) The equipment and operation of mine rescue stations established pursuant to this section shall be in charge of an officer of the Department designated by the Minister for that purpose, and it is the duty of the officer so designated to

(a) teach and train mine rescue crews and supervisors in the use and maintenance of the apparatus in such manner as the chief inspector directs,

(b) maintain the apparatus in efficient and workable condition so that it may be available for immediate use, and

(c) perform such other duties as the chief inspector deems necessary.

SECTION 3.2.3
NEW BRUNSWICK

NEW BRUNSWICK LEGISLATION
OCCUPATIONAL HEALTH AND SAFETY ACT
Extracted from Regulations - Rules 1130 to 1140

1130 Mine rescue stations shall be established, maintained and operated at such points in the Province as the Commission may direct.

1131 Every mine rescue station established pursuant to section 1130 shall be equipped and operated in a manner approved by the Chief Officer.

1132 The mine rescue officer shall teach and train mine rescue crews and supervisors in the use and maintenance of the apparatus in such manner as the Chief Officer directs, to maintain the apparatus in efficient and workable condition so as to be available for immediate use and to perform such other duties as the Chief Officer directs.

1133 The employer at a mine shall cause such employees and supervisors to be trained in the use and maintenance of mine rescue equipment as the rescue officer deems necessary.

1134 Each member of a mine rescue team is to receive a minimum of one day per month of refresher training in mine rescue procedures.

1135 All underground personnel shall receive a minimum one day basic training in the use of respiratory protection equipment and in the identification of gases through instruction by the mine rescue officer or his delegate.

1136 Mines located at a distance from any mine rescue station that would require travelling time in excess of thirty minutes, may be required to install such equipment and apparatus as the Chief Officer may direct, in a substation provided by the mine or group of mines in that area.

1137 Notwithstanding section 1136, a minimum of twelve self-contained oxygen breathing apparatus of an approved type shall be maintained in a state of readiness at each underground mining operation.

1138 The equipment and apparatus established in a substation as required by section 1136 shall be maintained in an efficient and workable condition at all times, by a trained mine employee, and the state of readiness of such equipment and apparatus shall be subject to periodic inspection and approval by the mine rescue officer.

1139 The employer is responsible for the supervision and direction of mine rescue crews in all mine rescue and recovery operations conducted at the mine.

1140 The Commission may apportion the costs of the mine rescue training program and the cost of operating and maintaining the mine rescue stations and equipment against the industry.

APPENDIX III
LEGISLATION

SECTION 3.3.1
ONTARIO

ONTARIO

AUTHORIZATION

The authority for organization and financing of the Mine Rescue Stations and the assignment of responsibilities are contained in the regulation made under the Occupational Health and Safety Act 1978, Section 16, Ontario Regulation 660/79.

(16) (1) Mine rescue stations may be established, equipped, operated and maintained in such locations as the Minister considers advisable.

(2) The cost of establishing, equipping, operating and maintaining the mine rescue stations shall be paid out of the Consolidated Revenue Fund in the first instance and shall be reimbursed quarterly by the Workmens Compensation Board from money assessed and levied by the Board upon employers in the mining industry to defray the cost certified by the Deputy Minister.

(3) Money received from the sale or disposal of any equipment, buildings or machinery used in mine rescue or any handbooks or publications on mine rescue shall be credited against the cost of mine rescue stations.

(4) A mine rescue station and the training of members of a mine rescue crew shall be under the direction of a mine rescue officer appointed by the Ministry.

(5) A mine rescue crew member shall possess such physical qualifications, and establish competency in mine rescue skills as described in the Handbook of Training in Mine Rescue and Recovery Operations, current edition, issued by the Ministry.

(6) The owner of a mine shall make available training facilities and workers to be taught and trained in mine rescue work at the expense of the owner.

(7) A mine rescue operation at a mine shall be under the direction of the supervisor in charge of the mine and the costs of the rescue operation shall be at the expense of the owner of the mine.

(8) Notice shall be given immediately to a mine rescue officer and to an engineer of the Ministry when the services of a mine rescue crew are required.

SECTION 3.3.2
QUEBEC

regulations for

the safety and protection of workmen

in

mines and quarries

established by orders-in-council in virtue of the

quebec mining act

department of natural resources
1971

S-113

261 — SAFETY REGULATIONS

(I) The Lieutenant-Governor in Council may make such regulations as he deems necessary respecting safety and health in mines, so as to protect the workmen therein employed.

263 — RESCUE STATIONS

(II) The chief inspector of mines shall fix the number of workmen in each mine who must follow a course on the use and maintenance of rescue apparatus. The operator shall choose from among the employees of his mine the members of each rescue crew, and must see that they follow the course.

(III) The operator of the mine where rescue operations are conducted shall be responsible for the supervision and direction of the rescue crews.

265 — INSPECTIONS

It shall be the duty of the mining inspectors to make, in the region assigned to them by the Minister, the inspections necessary for the observance of the regulations in the mines.

FIRE PROTECTION

36 — FIRE PROCEDURE TO BE POSTED

a) The operator of every mine shall have drawn up a general procedure to be followed in case of a fire below ground or on surface and all persons connected with the carrying out of such procedure shall be well informed of their duties.

b) Copies of the procedure, or suitable excerpts thereof, shall be kept posted in any shaft-house, hoist-room and in other prominent places.

37 — STENCH WARNING

a) Every mine worked from shafts or adits producing over one hundred tons of ore per day and such other mines as may be designated by the Inspector of Mines, shall be equipped with an approved apparatus for the introduction into the mine workings of ethyl mercaptan or other warning gas approved by the Inspector of Mines. Such apparatus shall at all times be kept ready for instant use for the purpose of warning workmen underground of any emergency necessitating a speedy evacuation of the workings. Sufficient personnel trained to operate this apparatus shall be readily available to do so whenever men are underground.

b) The apparatus for the injection of the stench warning gas shall not be located inside any building covering the mouth of a shaft or other entrance to underground workings.

c) A test of the effectiveness and functioning of the warning system shall be made at least once a year, and a report of such test shall be sent to the Inspector of Mines.

38 — FIRE-DOORS

The mine operator shall, where feasible, have installed a sufficient number of suitable fire-doors underground in order to, when necessary, effectively isolate each shaft from other workings of the mine. These doors shall be maintained in proper order and kept clear of all obstructions so as to be readily usable at all times.

39 — PRECAUTIONS AGAINST MINE FIRES

a) No flammable refuse shall be allowed to accumulate underground, but shall be removed from the workings at least once a week and brought to the surface and there disposed of in a suitable manner.

b) All waste timber not in use underground shall, as soon as practicable, be taken from underground and shall not be piled up and permitted to decay therein.

c) Lubricating oil and grease kept underground shall be contained in suitable closed metal receptacles and the amount so kept shall not exceed the requirements for seven days.

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44 — FIRE HAZARD AREA

If, in the opinion of the Inspector of Mines, a grave fire hazard exists in or about a mine, he may designate such mine or a part or parts of such mine as a "Fire Hazard Area". No person shall smoke or be allowed to smoke, use or have in his possession open flame lamps, matches or other means of producing heat or fire in such areas, without the permission of the Inspector of Mines, and under such conditions as he may deem proper. Such "fire hazard areas" shall be properly indicated by suitable signs. The operator shall cause such signs to be installed and maintained as long as the area is so designated.

45 — FIRE-FIGHTING EQUIPMENT UNDERGROUND

The mine operator shall provide and have maintained adequate and suitable fire-fighting equipment at all underground crusher stations, shaft and winze stations, pump stations, repair shops, tipples, underground electrical installations and at other places where, in the opinion of the Inspector of Mines, a fire hazard may exist.

47 — INSPECTION OF FIRE-FIGHTING EQUIPMENT

A properly authorized person shall make a thorough monthly inspection of all fire-fighting equipment, including fire doors and stench warning installations, and shall make a report in writing to the manager that such inspection has been made and certifying as to the conditions found. This report shall be kept on file and available for examination by the Inspector of Mines.

Revised Regulations of Québec

1981

VOLUME
9
R-11, r. 1
to
S-4, r. 1

Consolidated to 31 December 1981 by
the Commission de refonte des lois et des règlements
and published pursuant to the Act
respecting the consolidation of the statutes and regulations
(R.S.Q., c. R-3; am. S.Q., 1981, c. 23).

c. S-2.1, r.13

Regulation respecting mine rescue stations

An Act respecting occupational health and safety (S.Q., 1979, c. 63 ; after consolidation : R.S.Q., c. S-2.1)

1. The Commission de la santé et de la sécurité du travail may organize rescue stations for the mines of Québec, provide for their equipment and their maintenance, and maintain therein the personnel necessary for proper operation.

2. Every rescue station is under the control and supervision of a person appointed by virtue of the Civil Service Act (R.S.Q., c. F-3.1) and amendments. This person shall attend to the necessary instruction and training of the rescue crews and ensure the maintenance of the apparatus installed in each station.

3. The number of employees of each mine, which should follow a course of instruction and training in the use and maintenance of rescue apparatus, is determined by the chief inspector of mines, and the members of each rescue crew are chosen by the operator from the employees of his mine.

O.C. 404-56, (1956) 88 O.G. 1062

RÈGLEMENT
POSTES D'APPAREILS
DE SAUVETAGE DANS LES MINES

(Loi sur la sante et la securité du travail)

Commission de la santé
et de la securite du travail
du Quebec

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SECTION 3.3.3
MANITOBA

MANITOBA

THE MINES ACT

being

CHAPTER M160

of the

CONTINUING CONSOLIDATED STATUTES OF MANITOBA

with Amendments up to Feb. 1st, 1974

also

MANITOBA REGULATION 254/73

(M160-R3M)

Effective Nov. 1st, 1973

Being a Regulation Governing the Operation of Mines

Printed by R. S. EVANS
Queen's Printer for the Province of Manitoba
1974

POWERS OF LIEUTENANT GOVERNOR IN COUNCIL

Regulations.

7(1) For the purpose of carrying out the provisions of this Act or The Manitoba Natural Resources Act according to their intent, the Lieutenant Governor in Council may make such regulations and orders as are ancillary thereto and are not inconsistent therewith; and every regulation or order made under, and in accordance with the authority granted by, this section has the force of law; and, without restricting the generality of the foregoing, the Lieutenant Governor in Council may make such regulations and orders, not inconsistent with any other provision of this Act or The Manitoba Natural Resources Act, for

(n) prescribing certificates or other means of identification for inspectors;

(o) prescribing equipment and type and number of personnel required for mine rescue stations, the mode of operation and maintenance of, mine rescue stations and equipment, and the method of and courses for training mine rescue crews;

(p) the safety and health of workmen engaged or employed in and about mines;

(q) the inspection of mines, mine works, and all matters in connection therewith, and setting fees payable for such inspections;

(s) fencing off or other safety precautions in connection with unworked mines that may be closed down;

(x) fixing the amounts of deposits, assessments and charges to cover the cost of carrying out work relating to rehabilitation and protection of the environment and safety of the public during mining and after mining operations are discontinued.

MINE RESCUE STATIONS AND CREWS

Establishment of mine rescue stations.

42(1) The minister may, in writing, order the owner, manager or agent of a mine to establish, equip, operate and maintain a mine rescue station in respect of the mine.

Application of Regulations Act.

42(2) An order made under subsection (1) is not a regulation under The Regulations Act and that Act does not apply to it.

Costs.

42(3) The owner of the mine is responsible for the cost of establishing, equipping, operating and maintaining a mine rescue station and for providing and assuring that employees attend courses of training in mine rescue work.

Employee in charge of station.

42(4) The owner, manager or agent of a mine in respect of which an order has been made under subsection (1) shall appoint an official or employee of the owner of the mine to be responsible for and in charge of the operation, equipment and maintenance of the mine's rescue station and that official or employee shall keep the equipment in efficient and workable condition so that it may at any time be used.

Mine rescue crews.

42(5) Where the minister has made an order under subsection (1) in respect of a mine, the owner, manager or agent of the mine shall cause such workmen and supervisors as the director may deem necessary to be trained under the supervision of an inspector designated by the minister for the purpose in the use and maintenance of mine rescue equipment.

Supervision of mine rescue crews.

42(6) The manager of a mine in respect of which an order has been made under subsection (1) is responsible for, and shall supervise and direct, the mine rescue crews in all rescue or recovery operations conducted at the mine.

En. S.M. 1965, c. 50, s. 5.

Appointment of inspectors.

44 The minister may appoint persons as inspectors for the purpose of enforcing this Act and the regulations.

En. S.M. 19[illegible], c. [illegible], s. [illegible]

POWERS AND DUTIES OF INSPECTORS

Powers of inspectors.

45(1) An inspector may,

(a) make such examination and inquiry as he may deem necessary to ascertain whether the provisions of this Act or the regulations are complied with, and give notice to the owner or agent in writing of any particulars in which he considers a mine or any portion thereof, or any matter, thing or practice, to be dangerous or defective, or contrary to this Act or the regulations, and require them to be remedied within the time named in such notice and to give written notice to the inspector of the completion of any work.

(b) enter, inspect, and examine any mine, and any portion thereof, at all reasonable times by day and night, but so as not to impede unnecessarily or obstruct the working of the mine.

(c) order the immediate cessation of work in, and the departure of all persons from, any mine or portion thereof that he considers unsafe, or allow persons to continue to work therein on such precautions being taken as he deems necessary

SECTION 3.4.1
SASKATCHEWAN

CHAPTER O-1

An Act for the Promotion and Protection of the Health and Safety of Persons Engaged in Occupations

SHORT TITLE

Short title

1. This Act may be cited as *The Occupational Health and Safety Act*.

REGULATIONS AND CODES OF PRACTICE

Regulations

13. For the purpose of carrying out the provisions of this Act according to their intent, the Lieutenant Governor in Council may make regulations that are ancillary to and are not inconsistent with this Act, and every regulation made under this section has the force of law and, without restricting the generality of the foregoing, the Lieutenant Governor in Council may make regulations,

(*a*) defining any word or expression used in this Act but not defined in this Act;

(*b*) prescribing the standards to be established and maintained by employers and self-employed persons for the protection of the health and safety of workers and self-employed persons at places of employment;

(*m*) imposing requirements with respect to the provision and use in specified circumstances of protective clothing or equipment, including clothing affording protection against the hazards of work and against unusual exposure to the weather;

(*n*) imposing requirements with respect to the instruction, training and supervision of workers;

(*q*) requiring prompt notification of specified kinds of occupational injuries, illnesses and dangerous occurrences and prescribing actions to be taken or not to be performed to facilitate inquiry into and prevention of recurrences of such injuries, illnesses and dangerous occurrences;

(*r*) specifying conditions under which work of a hazardous nature may be performed;

(*s*) requiring notification of the branch respecting any person, premises or thing employed or used in specified hazardous activities as a condition of carrying on any such activity;

OCCUPATIONAL HEALTH OFFICERS.

Appointment of occupational health officers

16.—(1) The minister may appoint as occupational health officers any of the persons employed by or providing services to the branch.

(2) The minister may enter into an agreement with the government of any province specifying the terms and conditions under which a person employed by the government of that province may, for the purposes of this Act, act as an occupational health officer in Saskatchewan.

(3) The minister may, upon any terms and conditions he considers necessary, consent to have an occupational health officer carry out health and safety inspections or other work on behalf of the government of another province or the Government of Canada.

(4) The minister shall provide each occupational health officer with written credentials of his appointment and the occupational health officer shall produce his credentials upon request when exercising or seeking to exercise any of the powers conferred upon him by this Act or the regulations. 1976-77, c. 53, s. 16.

CHAPTER O-1 REG 1

THE OCCUPATIONAL HEALTH AND SAFETY ACT — SECTION 13

Order in Council 567/81, dated April 14, 1981.

(Filed April 15, 1981.)

ORDER

His Honour the Lieutenant Governor in Council, on the recommendation of the Minister of Labour, pursuant to section 13 of *The Occupational Health and Safety Act*, repeals Saskatchewan Regulations 55/81 and makes regulations in accordance with the attached Schedule, effective May 17, 1981.

SCHEDULE

PART I

TITLE AND INTERPRETATION

Title

1. These regulations may be cited as *The Occupational Health and General Regulations.*

Interpretation

2.—(1) In these regulations and every other regulation made under the Act:

"Act"

(*a*) "Act" means *The Occupational Health and Safety Act*;

PART II

DUTIES OF EMPLOYERS

General duties

5. Without limiting the generality of clause 3(*a*) of the Act, the duty of an employer under that clause includes:

(*c*) the provision of any information, instruction, training and supervision that is necessary to protect the health and safety of his workers at work; and

(*d*) the provision and maintenance of a safe means of access to and egress from the place of employment and to and from all work areas within the place of employment.

Supervision of work

6. Every employer shall, so far as is reasonably practicable, ensure that:

(*a*) all work at the place of employment is sufficiently and competently supervised;

8.—(1) Where a worker commences work at a place of employment, the employer shall provide him health and safety orientation instruction, upon the worker's starting work, during the time that he is at work and with no loss of pay.

(2) Health and safety orientation pursuant to subsection (1) must include instruction on:

(*a*) procedure in the event of fire or other emergency;

(*b*) first aid facilities;

(*c*) prohibited or restricted areas;

(*d*) chemical and physical hazards; and

(*e*) any other matters that are relevant to the health and safety of the worker while he is at work.

Province of Saskatchewan

SASKATCHEWAN REGULATION 284/78

THE OCCUPATIONAL HEALTH AND SAFETY ACT, 1977.
Order in Council 1317/78, dated August 29, 1978.

Published in The Saskatchewan Gazette, dated Friday, September 22, 1978; Volume 74, No. 38; Part II; Pages 723-787.

(Filed August 30, 1978.)

ORDER:

His Honour the Lieutenant Governor in Council on the recommendation of the Minister of Labour, pursuant to section 13 of The Occupational Health and Safety Act, 1977, hereby makes the Mines Regulations in accordance with the schedule hereto effective September 1st, 1978.

SCHEDULE

MINES REGULATIONS UNDER SECTION 13 OF THE OCCUPATIONAL HEALTH AND SAFETY ACT, 1977

Short Title

400.00 These regulations may be cited as "The Mines Regulations".

PART I

INTERPRETATION AND APPLICATION

Interpretation

402.00 In these regulations, unless the context otherwise requires, the expression;

"Act"

(a) "Act" means The Occupational Health and Safety Act, 1977;

"appointed physician"

(b) "appointed physician" means a medical practitioner appointed by the employer pursuant to section 24.00 of the occupational health and general regulations;

"approved"

(c) "approved" means approved by the chief inspector;

"chief inspector"

(d) "chief inspector" means the chief inspector of mines for the department;

"competent"

(e) "competent" means qualified by knowledge, experience and temperament to perform a specific duty;

"inspector"

(f) "inspector" means an occupational health officer appointed under the Act;

"employer at a mine"

(g) "employer at a mine" means any employer employing workers at a mine;

PART VI

SUPERVISION AND INSTRUCTION OF WORKERS

Responsibility for appointing competent persons

412.00 Except as otherwise herein provided the employer at a mine shall appoint sufficient number of competent persons to undertake duties pursuant to these regulations.

Supervisor's to require certificates

412.04 (1) After January 1, 1980, every worker employed underground or in an open pit working at a mine shall be under the daily supervision of a supervisor who has been appointed by the employer at a mine and satisfies the requirements of subsection (2).

(2) The supervisor shall,

(c) where applicable to the type of mine and duties to be performed, hold a certificate of competency in supervisory duties in an emergency as prescribed in section 418.02, an authorization to blast as prescribed in section 422.02 and a first aid certificate approved by the chief occupational medical officer.

Instruction required

412.12 (1) The employer at a mine shall institute a scheme whereby every worker who has newly commenced work at that mine or been assigned work underground or in an open pit for the first time or been assigned any other work for which he has not received instruction be given subject to subsection 5,

(a) adequate instruction respecting the Act and associated regulations applicable to that work;

(b) adequate information on the available first aid facilities and procedures for treatment of injury at that mine;

(c) adequate instruction on procedures in event of a fire or any other reasonably foreseeable emergency at the mine relevant to that worker's place of work;

(d) adequate instruction in the safe and healthy procedures to be used in performing his work; and

(e) an adequate period of time under close supervision to become familiar with the dangers of his work.

Check-in and check-out system

414.14 The mine employer at every underground mine shall provide and maintain an effective system to record workers who go underground and record those workers who return to the surface and the record shall be examined at suitable intervals by competent persons who shall report forthwith to the employer when any worker is not accounted for.

Marking means of egress

414.16 The mine employer at an underground mine shall,

(a) post legible signs showing the means of egress in prominent places underground;

(b) post legible signs identifying every working place and travelway;

(c) post in conspicuous positions underground a current mine plan showing the workings, ventilation and means of egress.

Precautions when working on a stockpile

414.32—(1) The mine employer where material is stored in a stockpile shall prepare suitable rules to ensure so far as is reasonably practicable that the stockpile is operated in a safe manner and that workers use safe working procedures.

(2) The rules for the operation of a stockpile shall without restricting the generality of the foregoing subsection include provisions for,

(a) the supervision of the operations on that stockpile;

(b) the training of workers on that stockpile;

(c) any necessary limitations on the use of equipment on or in the vicinity of that stockpile;

(d) controlling the formation of dangerous slopes or undermining of that stockpile;

(e) the control of drawpoints and dumping operations.

(3) The rules required under this section shall be prominently posted in such a manner that they are accessible at all times to workers working on that stockpile.

(4) Every employer at the mine and every worker working on a stockpile shall comply with the rules so posted.

PART VIII

FIRE PREVENTION AND CONTROL AND EMERGENCY PROCEDURES

Prevention and control of fire at a mine

416.00—(1) The employer at every mine shall take all reasonably practicable steps to prevent an outbreak of fire at the mine and provide effective means to control any fire that may occur at the mine.

(2) The mine employer shall draw up an effective procedure which shall provide for the safety of all workers in the event of a fire and the control of that fire whether on the surface or underground.

(3) The employer at a mine shall inform each worker of, and instruct him in, any duties which he may be required to perform by virtue of subsection (2).

(4) The mine employer shall post the details of the procedure at suitable places on the surface and underground at the mine.

Provision and testing of warning system

416.02—(1) At every underground mine producing over one hundred tons of ore per day and any other mine that may be designated by an inspector the mine employer shall provide a suitable emergency warning system and the details of the system shall be submitted to the chief inspector before installation and any subsequent modification; and

(a) this system shall at all times be made available and kept ready for instant use for the purpose of warning workers underground of an emergency.

(b) every worker shall proceed when the warning is activated to the shaft station or as otherwise provided for in the procedures stated in section 416.0

(2) At least once in each year the mine employer shall test the procedure required by section 416.00 by a simulated emergency and a report and plan shall be submitted to the chief inspector forthwith describing the simulated conditions at the mine and the effectiveness of the procedure.

(3) A test of the effectiveness of the emergency warning system which may be combined with the test required by subsection (2) shall be made at least once in each year, or as required by an inspector, and a report of such tests including the functioning of any equipment shall be submitted by the mine employer to the chief inspector forthwith.

(4) An inspector may require the modification of the procedure where any test required by virtue of subsection (2) indicates that the existing method is inadequate.

(5) The employer at a mine shall give to every worker working underground instruction on the warning system and the procedures to be adopted when the system is activated.

(6) The mine employer at a mine shall ensure so far as is reasonably practicable that any place where a serious fire could develop underground at a mine shall be monitored by a heat sensing device coupled to an alarm or fire suppression system.

PART IX
MINE RESCUE

Establishment of mine rescue stations and substations, etc.

418.00 (1) Every mine employer situated in an area where there is not a mine rescue station established by the division shall install, equip, operate and maintain a mine rescue substation at such place and in such a manner as the chief inspector may direct.

(2) At every mine rescue substation directed by the chief inspector to be established under subsection (1),

(a) such equipment as the chief inspector may direct shall be installed and maintained; and

(b) the mine employer shall appoint a person who shall possess a certificate of competency in mine rescue instruction to be responsible for the maintenance of the equipment and training of mine rescue teams.

Certificates of competency in mine rescue

418.02 The chief inspector may issue a certificate of competency to any person who has demonstrated by examination or otherwise that that person is competent to undertake the duties specified in these regulations as a holder of that certificate and such certificates shall be called,

(a) "certificate of competency in mine rescue work";

(b) "certificate of competency in mine rescue instruction";

(c) "certificate of competency in supervisory duties in an emergency".

Provision of mine rescue personnel

418.04 (1) Every mine employer shall cause a sufficient number of workers including supervisors to be trained by a competent person as mine rescue persons and the chief inspector may specify the number of workers who should be trained and the content of their training program.

(2) The mine employer shall cause a sufficient number of workers trained as mine rescue persons to be readily available and the chief inspector may specify the number of workers who shall be available.

(3) No worker shall be qualified to be a mine rescue person unless that worker has,

(a) been certified within the last preceding twelve months, by a physician, to be fit to work in breathing apparatus under arduous conditions;

(b) a certificate of competency in mine rescue work and is trained in the use of the breathing apparatus in use at the mine; and

(c) has taken part in such training sessions during the preceding twelve months as may be specified by the chief inspector.

(4) The mine employer shall keep a record of all certificates required by subsection (3).

(5) (a) The mine employer shall prepare a procedure to be adopted in the event that it is necessary to call out and employ mine rescue personnel in an emergency; and

(b) the procedure shall be kept posted in prominent places and every worker involved in the procedure shall be instructed in that worker's duties.

Supervision of mine rescue operations

418.06 The mine employer shall appoint a competent person or persons who shall supervise, subject to any direction that may be received from the chief inspector, mine rescue teams in all mine rescue work and recovery operations conducted at a mine.

Restriction on workers taking part in rescue work

418.08 The mine employer shall not permit any worker to take part in any mine rescue operation involving the use of breathing apparatus unless that person,

(a) has been authorized to do so; and

(b) has been medically examined by a physician at the time of the operation except that in an emergency, in the initial stages of an operation, it will be sufficient for the worker to have had the medical examination within the last twelve months.

Mine rescue to be performed only by a team

418.10 The mine employer shall,

(a) not permit any worker to take part in a rescue operation involving the use of breathing apparatus except as a member of a team of no less than five mine rescue persons or such other number as the chief inspector may permit where this can be done without prejudice to the safety of workers;

(b) appoint a competent team captain who shall have direct control and be responsible for the safety of the team and shall not take part in any work other than that directly involving the safety of the team.

Provision of refuge stations and rescue equipment

418.12 (1) The mine employer shall provide and maintain such refuge stations as are necessary for the protection of workers employed underground and every such refuge station shall be provided with food, water, air, first aid supplies and telephonic communication to the surface. Such stations shall be separated from adjoining workings by doors or stoppings so arranged and equipped that any noxious atmosphere can be prevented from entering the station.

(2) The chief inspector may direct that a refuge station be provided where he has reason to believe this is necessary for the protection of the workers.

(3) Every refuge station shall be located accurately with respect to surface coordinates.

(4) The mine employer shall provide and maintain in every underground hoistroom suitable respiratory protective equipment for the hoist operator and every hoist operator shall be adequately trained in its use.

Self rescue apparatus

418.14 (1) The chief inspector may require where there is adequate reason to do so that the mine employer shall make suitable provision whereby every worker in a mine or part of a mine shall at all times carry self-rescue apparatus or that sufficient self-rescue apparatus is stored in a suitable place or places underground.

(2) The mine employer shall instruct each worker who may be required to use self-rescue equipment in the proper method of use and the dangers of using such equipment improperly.

(3) Nothing in these regulations shall prevent the use of self-rescue apparatus by workers underground in an emergency for the purpose of securing their safety.

Maintenance of breathing apparatus

418.16 The mine employer shall,

(a) adequately maintain all testing apparatus, breathing apparatus and resuscitating apparatus and refuge stations required by this part;

(b) appoint a person who shall examine all such apparatus and stations and report in writing to the employer as to their condition at intervals not exceeding one month;

(c) countersign such a report and ensure that any deficiencies are corrected forthwith.

SECTION 3.4.2
ALBERTA

THE COAL MINES SAFETY ACT

Chapter 18

(Assented to June 6, 1974)

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of Alberta, enacts as follows:

1. In this Act,

---

5. "certificate" means a certificate granted under this Act or The Coal Mines Regulation Act entitling the holder to perform the duties of the occupation or office in respect of which the certificate is granted, but does not include a miner's certificate or miner's permit;

PART 1

PURPOSES AND APPLICATION OF THE ACT

2. This Act applies to every mine site, mine and processing plant in Alberta, to the persons employed thereat, and to all coal produced in Alberta.

3. The purposes of this Act are
   - (a) to secure the observance of safe practices in the exploration for, mining, storage, processing and transporting of coal,
   - (b) to provide for and ensure the safety and preservation of health of all persons employed at or otherwise authorized to enter a mine site and its various connected facilities,
   - (c) to establish the technical qualifications for certain persons employed in and about mine sites, and
   - (d) to secure the provision and use of safe and proper equipment and installations in and about mine sites.

PART 3

POWERS AND DUTIES OF THE BOARD

Orders, Directions and Regulations

5. (1) Except where otherwise provided, the Board has exclusive jurisdiction to examine, inquire into, hear and determine all matters or questions arising under this Act.

(2) The Board, with the approval of the Lieutenant Governor in Council, may make such just and reasonable orders or directions as may be necessary to effect the purposes of this Act but which are not otherwise specifically authorized by this Act.

6. The Board shall, when required by the Lieutenant Governor in Council, or may upon its own motion, inquire into, examine and investigate any matter referred to in section 3 and publish reports, maps, statistical material and other documents relating to those matters.

7. (1) The Lieutenant Governor in Council may make regulations

1. prescribing the qualifications and duties of persons appointed to the Panel;
2. prescribing the qualifications for, and procedures to be followed on applications for, certificates, miner's certificates and miner's permits;
3. prescribing the qualifications and duties of mine officials;

10. prescribing miscellaneous safety provisions with respect to coal barriers, accumulations of water and gas, use of gas detectors and safety lamps, combined operations, machinery and installations, actions of and communications between persons, prevention of fires and accidents, use of protective clothing, standards and erection of buildings, signs and barricades;
11. requiring the establishment of mine rescue stations, rescue training and rescue practices, fire precautions, and provision of first aid or hospital facilities;
12. governing the appointment, qualifications and duties of mine rescue teams;

30. The manager shall, unless exempted therefrom by the Board in writing, establish a rescue organization which shall be submitted to the Board for approval and that shall include

(a) a mine rescue station,
(b) a qualified mine rescue training officer,
(c) one or more rescue teams, and
(d) all prescribed equipment for emergency operations.

Accident Reports

48.

(2) When in or about a mine site a personal injury occurs that is caused by

(a) the breaking of a hoisting rope, or
(b) an explosion or an explosive

the manager shall, within 24 hours, send to the Board and the district Board office a notice in the prescribed form.

(4) When, at a mine site,

(a) an explosion of gas or coal dust occurs, or
(b) an explosive explodes prematurely, or
(c) a fire occurs, or
(d) any gas ignites, or
(e) an accident occurs that could have injured a person, although no injury in fact resulted,

the manager shall immediately notify the Board or the district Board office.

THE COAL MINES SAFETY ACT

COAL MINES SAFETY REGULATIONS

(Alberta Regulation 333/75)

PART 1

GENERAL

Division 5

Emergency Organization

First Aid and Hospital Facilities

69. (1) The manager shall keep or cause to be kept, appropriately constructed ambulances, stretchers, splints, bandages, blankets and sufficient medical and other first aid supplies at each mine ready for immediate use in case of accident.

(2) The bandages, blankets, medical and other supplies shall be maintained at all times in a clean, sanitary condition.

(3) First aid supplies in an underground mine shall be kept in a damp-proof container and be located at or near the working places and shall be readily available and accessible during all working hours.

70. (1) The manager shall furnish first aid pocket kits to each senior foreman, foreman, shot-firer and blaster, which shall be carried during his working shift.

(2) A person carrying a first aid kit shall report to the manager or to a person authorized by the manager when fresh supplies for the kit are required.

71. The manager shall provide and maintain at each mine in a convenient place at least two beds properly furnished and suitable for temporary use of persons injured at the mine, unless

(a) there is a hospital at or within 5 miles of the mine, or

(b) there is a suitable ambulance properly maintained and available at all times, or

(c) exemption has been granted by the Board in writing.

Emergency Plans

72. The manager shall maintain, to the satisfaction of the district Board representative, emergency organization plans and charts for the mine in a place readily available to all persons responsible for action in any emergency at the mine.

Provision of Emergency Lighting

73. (1) Standby emergency lighting shall be provided for use in the event of a failure of the power supply

(a) at the medical centre, first aid room, and mine rescue station,

(b) at the wash house or changing room,

(c) on all machines where stairways, walkways or ladders are normally used by operating personnel,

(d) at any main control or switch room where switching is carried out,

(e) at any coal preparation or tripple plant at stairways, walkways or ladders normally used by operating personnel, and

(f) at every winding engine house or surface haulage house.

(2) The Board may grant relief from the requirements of this section where all personnel employed, as a condition of their employment, carry individual cap lamps.

Mine Rescue Stations

74. The owner of a mine shall

(a) establish, maintain and operate a mine rescue station to provide facilities for the conduct of operations for rescue and other necessary work at that mine after an explosion, fire, fall of ground, or in an atmosphere which is or may be irrespirable or liable to become irrespirable, or

(b) make arrangements to ensure that there are available to that mine such facilities provided by a neighbouring mine rescue station or central rescue station situated at a distance of not more than that authorized by the Board.

75. (1) The owner shall cause to be provided and maintained at the rescue station required by section 74, rescue apparatus approved by the Board.

(2) The apparatus required by subsection (1) shall be

(a) continuously maintained in an efficient and workable condition,

(b) so stored as to be always available for immediate use, and

(c) in the case of a mine at which an irrespirable atmosphere might develop, the apparatus shall include self-contained breathing apparatus of a type approved by the Board.

Supplementary Stations

76. (1) For the purpose of supplementing, in case of need, the rescue apparatus maintained under section 75, the Board may require rescue stations to be established at such places as it considers necessary.

(2) Such stations shall be equipped and maintained in accordance with the direction of the Board.

Training Persons

77. The manager of a mine shall

(a) ensure that a sufficient number of persons are trained in the use and maintenance of rescue equipment and apparatus, and

(b) cause a number of such persons to be trained in the use of self-contained breathing apparatus.

Rescue Officials

78. No person shall be a mine rescue station training officer unless he holds

(a) a certificate in mine rescue work, and

(b) a first aid certificate.

Examinations and Training

79. The Board representative from time to time shall

(a) conduct examinations of applicants for a mine rescue certificate,

(b) supervise mine rescue training methods, and

(c) make inspections of each mine rescue station.

Duties of a Rescue Training Officer

80. A mine rescue training officer shall

(a) continuously maintain mine rescue equipment and breathing apparatus in an efficient, workable and sanitary condition,

(b) ensure the proper storage of mine rescue equipment and breathing apparatus,

(c) ensure that updated mine plans are posted in the rescue station and that the team captain and members are advised of changes on the plans,

(d) train mine rescue teams,

(e) instruct holders of mine rescue certificates and other persons in the use and operation of mine rescue equipment and breathing apparatus,

(f) supervise mine rescue team practices,

(g) conduct courses in mine rescue for candidates for a mine rescue certificate, and

(h) keep a record of attendance for each practice of the mine rescue team.

Training

81. (1) A person wishing to obtain mine rescue instruction may make application to any mine rescue training officer.

(2) No applicant shall be trained in mine rescue work unless he has passed a medical examination conducted by a duly qualified medical practitioner.

82. A course in mine rescue training shall consist of ten two-hour training periods given by a mine rescue training officer.

83. (1) No person shall be awarded a mine rescue certificate unless he

(a) is at least 21 years of age,

(b) has completed a course in mine rescue training,

(c) has passed an examination on the use and care of self-contained breathing apparatus, and methods and practices of mine rescue work, and

(d) is the holder of a first aid certificate.

(2) Upon a person complying with subsection (1) the Board, upon the recommendation of the Board representative, shall award to the person a mine rescue certificate.

(3) The holder of a mine rescue certificate issued before the enactment of these regulations is considered to be the holder of a mine rescue certificate under these regulations.

(4) Upon the recommendation of a Board representative the Board may issue a mine rescue certificate to a person who is the holder of a comparable certificate.

Qualifications

84. No person shall be a member of a mine rescue team unless he

- (a) is the holder of a mine rescue certificate,
- (b) is under the age of 45 years, or such other age as may be specified in a particular case by the Board,
- (c) has passed a medical examination within the last year, and
- (d) has been appointed a member of the mine rescue team by the mine rescue training officer with the consent of the mine manager and the district Board representative.

85. (1) Except in an emergency, the normal complement of a mine rescue team shall be five members.

(2) The mine rescue training officer shall designate one member of the team as captain and one member as vice-captain.

(3) In the event of any vacancy in the membership of a team caused by the absence or incapacity of a member, the mine rescue training officer shall immediately appoint the holder of a mine rescue certificate as an acting member.

86. (1) A mine rescue team shall practice at least once a month for a practice period of not less than two hours.

(2) The members of a mine rescue team shall make periodic tours of the workings at the mine site for the purpose of maintaining familiarity with the mine layout and the location of the means affording entry into egress from the working places.

87. (1) In the event of an emergency at a mine outside the operating zone of a mine rescue station and a request being received by that station for the services of the rescue team centred thereat, permission shall be obtained from the Board representative prior to the team moving.

(2) Where application for permission under subsection (1) cannot reasonably be made to either the Board representative or the Board, the decision may be made by the mine rescue training officer who will notify the nearest other mine rescue station and the Board as soon as possible.

88. (1) The manager of a small mine or exploration adit shall make himself award of the location and means of communication with the nearest mine rescue station.

(2) In the event of an emergency at a small mine, or exploration adit, the mine rescue training officer of the nearest rescue team and the Board shall be informed.

(3) The manager of a small mine or exploration adit shall be familiar with the closest access route by road, and familiar with the availability of a landing strip or other facility for aircraft landing closest to the mine or adit.

ENERGY RESOURCES CONSERVATION BOARD
Calgary Alberta

Information Letter
81-22

TO: OPERATORS OF UNDERGROUND COAL MINES

UNDERGROUND FIRE FIGHTING

CODE OF PRACTICE

FOREWORD

This Code of Practice outlines the requirements for personnel and equipment to combat an outbreak of fire in underground mines. It establishes minimum standards and it is not intended to discourage or prohibit consideration of additional safety features or improved techniques.

UNDERGROUND FIRE FIGHTING

9. Training, Drills and Practices

9.1 Persons newly employed at a mine shall be given instruction in the use of fire fighting equipment during their initial period of employment.

9.2 All persons who work underground shall be given refresher training in the use of fire fighting equipment at intervals not exceeding two years.

9.3 The date on which each person received initial and refresher training shall be entered on his employment record.

9.4 Persons trained as instructors shall be appointed by the manager.

9.5 Fire drills shall be held in each section of the mine such that every person who works underground shall receive a fire drill at intervals not exceeding six calendar months.

9.6 All drills and practices shall be recorded by a person appointed by the manager, countersigned by the assistant manager, and any deficiencies brought to the attention of the manager.

10. Fire and Smoke Detection

The approval of the Board shall be obtained prior to the installation of any system of fire and smoke detectors or monitors.

11. Emergency Organization Plan

The Emergency Organization Plan required by Division 5 of Part 1 of the Coal Mines Safety Regulations shall include the following:

11.1 The scale shall be not less than 1:2500 and show a scale bar and north point.

11.2 The position of all fire ranges, hydrants, valves, fire stations and fire boxes shall be shown on the plan.

11.3 The plan shall be up-dated at intervals of not more than three months.

SECTION 3.4.3
BRITSH COLUMBIA

Mine Regulation Act

[Consolidated September 4, 1981.]

MINING REGULATION ACT

[Repealed 1980-28-47, to be proclaimed]

CHAPTER 265

[Act administered by the Ministry of Energy, Mines and Petroleum Resources]

Part	Section
1. General	1 - 21
2. Rules	22 - 338
3. Offences, Regulations	339 - 346

PART 1

..

Accident causing loss of life or serious injury

7. (1) Where in or about a mine, whether above or below ground, loss of life or serious personal injury to a person employed in it occurs through accident, the owner, agent or manager of it shall immediately communicate information as to the time, place and nature of the accident to the chief inspector or the district inspector by telephone, telegraph or messenger, if those means of communication are reasonably available, and in addition shall, not later than 24 hours after the accident, mail a notice in writing of it, and of the loss of life or personal injury, to the inspector and to the chief inspector, respectively, and shall specify in the notice the time, place, nature and extent of the accident and the names of persons killed or injured.

(2) Where personal injury, of which notice is required to be given under this section, results in the death of the person injured, the owner, agent or manager shall mail notice in writing of the death to the chief inspector and to the inspector, respectively, within 24 hours after the death comes to the knowledge of the owner, agent or manager.

(3) No person shall, except to save or relieve human suffering, interfere with, destroy, carry away or alter the position of any wreckage, article or thing at the scene or connected with the accident, except with the approval of the inspector or chief inspector.

Refuge stations in mines

126. (1) Where the inspector considers it necessary or advisable for the protection of workers employed underground, the inspector may order refuge stations to be provided and maintained at directed places in the mine.

(2) Every refuge station shall

- (a) have water, air and telephone connections to the surface; and
- (b) be separated from the adjoining workings by closable openings arranged and equipped so that gases can be prevented from entering the refuge station.

1967-25-23(Rule 104).

Stench warning

127. (1) Those mines designated by the inspector shall be equipped with an apparatus approved by the inspector for the introduction into the mine workings of ethyl mercaptan or other warning gas approved by the inspector.

(2) The apparatus shall at all times be made available and kept ready for instant use for the purpose of warning workers underground of an emergency necessitating a speedy evacuation of the workings.

(3) When directed by the inspector, a test of the effectiveness of the warning and a report as to the functioning of the system shall be made, and a report of the test and functioning shall be made available to the inspector.

1967-25-23(Rule 105).

Exit signs

128. Legible signs showing the way to emergency exits shall be posted in prominent places underground and all workers shall be instructed as to the location of those exits.

Mine rescue apparatus

138. (1) The owner of a mine shall cause to be provided and maintained at the mine the mine rescue apparatus the inspector by order directs. All apparatus provided shall be continuously maintained in an efficient and workable condition and shall be stored or placed in or about the mine so as to be always available for immediate use.

(2) To supplement, in case of need, the mine rescue apparatus maintained under subsection (1), the minister may establish mine rescue stations at places in the Province the chief inspector considers necessary, all of which shall be equipped and maintained by the Ministry of Energy, Mines and Petroleum Resources under the direction of the chief inspector.

(3) The owner, agent and manager of a mine shall cause the number of workers the inspector considers necessary to be trained in the use and maintenance of mine rescue apparatus.

(4) There shall be provided and maintained in an underground hoist room suitable respiratory protective equipment for the hoist operator, and every hoist operator shall be adequately trained in its use.

(5) The owner, agent and manager of an underground mine shall ensure that all persons working underground are trained in survival rescue procedures.

1967-25-23(Rule 116); 1973-131-23; 1975-41-4; 1977-75-1; B.C. Reg. 91/79.

Fire hazard areas

139. (1) If the inspector believes that a fire hazard may be created at a mine by smoking or by the use of open flame lamps, matches or other means of producing heat or fire, the inspector may designate a mine or parts of it as a fire hazard area.

(2) No person shall smoke or be allowed to smoke, use open flame lamps, matches or other means of producing heat or fire in those areas except with the permission in writing of the inspector and under the conditions the inspector considers proper.

(3) Fire hazard areas shall be properly identified by suitable warning signs.

(4) The owner or manager shall cause the signs to be installed and maintained as long as the area is designated as a fire hazard area.

1967-25-23(Rule 117).

Interpretation

140. (1) Unless otherwise stated, this section and sections 141 to 235 apply to all hoisting engines used at mine shafts and to any other hoisting engine used for the transport of persons.

(2) In this Part

"drum hoist" means the type of hoisting engine where the rope is anchored to and spooled on to a drum;

Coal Mines Regulation Act

[*Consolidated for convenience only, January 17, 1977.*]

Title.

1. This Act may be cited as the *Coal Mines Regulation Act.* 1969, c. 3, s. 1.

Interpretation.

2. In this Act, unless the context otherwise requires,

"chief inspector" means the officer of the Ministry of Mines and Petroleum Resources appointed and known as the Chief Inspector of Mines;

"competent person" means a person skilled in and appointed for the purpose of doing the class of work specified, and, where a certificate of competency is required under this Act, means a person holding such a certificate;

PART I

ADMINISTRATION

Appointment of inspectors.

3. (1) There may be appointed, pursuant to the *Public Service Act,* qualified persons as

(*a*) inspectors of mines;

(*b*) inspectors of electrical equipment, who shall be known as "electrical inspectors";

(*c*) inspectors of mechanical equipment, who shall be known as "mechanical inspectors";

(*d*) inspectors of dust, ventilation, and noise conditions, who shall be known as environmental control inspectors", and

(*e*) inspectors of reclamation who shall be known as "reclamation inspectors".

(2) The chief inspector shall prescribe the qualifications and duties of inspectors. 1969, c. 3, s. 3; 1972 (2nd Sess.), c. 100, s. 2.

Report on accident causing loss of life or personal injury.

4. (1) The Minister may at any time direct the chief inspector to make an investigation and report with respect to any unusual or dangerous occurrence and any accident in a mine that has caused loss of life or personal injury, and the minister shall cause the report to be made public at such time and in such manner as he thinks fit.

Powers on an investigation.

(2) The chief inspector conducting an investigation under this section has the powers of a commissioner appointed under the *Public Inquiries Act.*

Notice to inspector of dangerous occurrences.

10. Where in or about a mine there is a dangerous occurrence involving

- (*a*) overwinding of a cage, skip, elevator, or bucket; or
- (*b*) breakage of a rope used for hoisting persons; or
- (*c*) inrush of water; or
- (*d*) fire undergound; or
- (*e*) premature or unexpected explosion of explosives or gas; or
- (*f*) inflow of explosive or other dangerous gases; or
- (*g*) breakdown of main ventilation system; or
- (*h*) vehicles going out of control; or
- (*i*) any other unusual occurrence,

and where notice thereof is not required to be given under section 9, the owner, agent, or manager shall, within twenty-four hours after the occurrence, mail a notice in writing to the inspector, and shall furnish such particulars as may assist the inspector in making inquiry into the occurrence. 1969, c. 3, s. 10; 1973 (2nd Sess.), c. 100, s. 9

Rescue apparatus required.

22. (1) The owner, agent, or manager shall cause to be provided and maintained at the mine such rescue apparatus as the inspector by order directs, and all apparatus so provided shall be continuously maintained in an efficient and workable condition, and shall be so stored or placed in or about the mine as to be always available for immediate use.

Rescue-stations.

(2) For the purpose of supplementing, in case of need, the rescue apparatus maintained under subsection (1), the minister may establish rescue-stations at such places in the Province as the chief inspector considers necessary, to be equipped and maintained under the direction of the chief inspector.

Training in use of rescue apparatus.

(3) The owner, agent, or manager of every mine shall cause such number of workmen as the inspector considers necessary to be trained in the use and maintenance of rescue apparatus.

Respiratory protection for hoistmen.

(4) There shall be provided and maintained in every underground hoistroom suitable respiratory protective equipment for the hoistmen, and every hoistman shall be adequately trained in its use.

Training in survival and rescue procedures.

(5) The owner, agent, or manager of every underground mine shall ensure that all persons working underground are trained in survival and rescue procedures. 1969, c. 3, s. 22; 1973 (2nd Sess.), c. 100, s. 14; 1975, c. 10, s. 5.

Fire-doors.

RULE 123. (*a*) Where practicable, there shall be a sufficient number of fire-doors installed underground in every mine to cut off the shaft or other entrance from the other workings of the mine.

(*b*) Where fire-doors are installed, they shall be of fire-resistant construction and

- (i) maintained in proper order; and
- (ii) kept clear of all obstructions so as to be readily usable at all times.

Refuge-stations within mines.

RULE 124. (*a*) Where the inspector considers it necessary or advisable for the protection of workmen employed underground, he may order refuge-stations to be provided and maintained at such places within the mine as he directs.

(*b*) Every such refuge-station shall

- (i) have water, air, and telephone connections to the surface; and
- (ii) be separated from the adjoining workings by closable openings so arranged and equipped that gases can be prevented from entering the refuge-station.

Fire-fighting equipment underground.

RULE 125. (*a*) Adequate and suitable fire-fighting equipment shall be provided and maintained at all underground crusher-stations, electrical installations, pump-stations, shaft-stations, and tipples, except where in the opinion of the inspector no fire hazard exists.

(*b*) Such equipment shall be conveniently located and conspicuously marked.

Fire-fighting equipment.

RULE 132. (*a*) In every underground mine, other than mines which are naturally wet throughout, the manager shall provide, at places approved by him in relation to the working-places, conveyer-lines, and roadways, a sufficient supply of rock dust or portable fire-extinguishers that can readily be used in case of fire.

(*b*) The foregoing subrule does not apply if a piped water supply with hydrants and equipment is provided that can readily be used in case of fire.

Prevention of ignition.

RULE 133. (1) Where, at any mine, machinery for cutting or getting coal is in use at a working-face at which an ignition of gas has been or, owing to the nature of the strata, is liable to be produced by such machinery, the manager shall ensure that

- (*a*) the machine is provided with effective means to prevent such ignition; or
- (*b*) a portable fire-extinguisher or a supply of suitable dust or sand is carried on or near the machine.

SECTION 3.4.4
YUKON AND N.W.T.

MINE RESCUE LEGISLATION

YUKON AND NORTHWEST TERRITORIES

In the Yukon Territories, mine rescue is regulated under the Yukon Territory Mining Safety Ordinance (R.O. 1958, C.75, S.1). Mine rescue capabilities are required only in mines where an Inspector is of the opinion that they may be necessary.

Each mine is required to have a sufficient number of trained rescue personnel. Based on the number employed, assessments are made to determine the contribution which a mine will pay towards the mine rescue service costs. The remaining, major, portion of the cost is borne by the Federal department of Indian and Northern Affairs.

In the N.W.T. mine rescue is regulated in the same way as for the Yukon. The Chief Inspector determines where mine rescue facilities are to be set up according to his assessment of the mine-site conditions and needs. Financing of the service is provided for in the same way as described for the Yukon. that is by applying an assessment on the mines with the remaining costs paid through the Territorial government from Federal funding. (see copy of Mining Safety Ordinance following)

Amendments:

1. No. 585-74, Sept. 30, 1974

377-71

MINING SAFETY ORDINANCE

The undersigned, pursuant to the *Mining Safety Ordinance*, hereby orders as follows:

1. The Mining Safety Rules established by Commissioner's Order dated November 26, 1956, as amended, are hereby revoked.
2. The Mining Safety Rules as set out in the Schedule annexed hereto are hereby made and established.

Dated at Yellowknife, this 21st day of September, 1971.

Stuart M. Hodgson,
Commissioner of the
Northwest Territories.

ACCIDENTS, SPECIAL OCCURRENCES AND RESCUE WORK

Notification of accident

35. (1) Where an accident occurs in a mine, the manager of the mine shall forthwith notify

(a) if the accident has caused serious injury to a person, an inspector and the mine safety committee referred to in section 10 of the mine in which the accident occurred; and

(b) if the accident has caused loss of life, an inspector, a coroner and the mine safety committee.

Scene not to be disturbed

(2) Subject to subsection (3), no person shall, except for the purpose of saving life or relieving suffering, interfere with, destroy, carry away or alter the position of any wreckage, article or thing at the scene of or connected with an accident until an inspector or a member of the Royal Canadian Mounted Police has completed an investigation of all circumstances surrounding the accident.

Permission to alter scene

(3) Where it is not possible to make an immediate investigation under subsection (2), an inspector may permit the wreckage, articles or things at the scene of or connected with an accident to be removed to such an extent as may be necessary to permit the work of the mine to be continued, but photographs or drawings showing the details of the scene of the accident shall be made prior to such removal.

R.O.,c.70,s.27; 1957(1st), c.16, s.15.

Notice of special occurrences

36. (1) Where in or about any mine

(a) an accident involving the hoist, sheaves, hoisting rope, shaft conveyance or shaft timbering,

(b) an inrush of water from old workings or otherwise,

(c) a failure of an underground dam or bulkhead;

(d) any outbreak of fire below ground or an outbreak of fire above ground that endangers any structure;

(e) a premature or unexpected explosion or ignition of explosives;

(f) asphyxiation effecting a partial or total loss of physical control;

(g) inflammable gas in the mine workings;

(h) unexpected and non-controlled extensive subsidence or caving of mine workings, or

(i) any explosion or outbreak of fire in any way related to the operation of an air compressor, air receiver, compressed air line or steam boiler,

occurs, whether or not loss of life or injury is caused thereby, the owner, manager or agent of a mine shall, within twenty-four hours after such occurrence, send notice, in writing and in duplicate, to an inspector of such occurrence and shall also furnish the inspector with such particulars as he may require.

Notice of fire

(2) Where in or about any mine an outbreak of fire occurs that endangers the health or safety of any person and the services of the mine rescue station are required, the owner or manager shall immediately notify the mine rescue superintendent and an inspector.

Rockburst

(3) Where a rockburst, whether or not personal injury or death is caused thereby, is determined to have occurred within the workings of any mine, the owner or manager shall, within twenty-four hours after such determination, send a written notice to an inspector notifying him thereof and shall furnish such particulars as he may require.

Record of rockbursts

(4) Records of rockbursts shall be kept at every mine

showing as far as possible their times, locations and extent, the injuries caused to persons and any other relevant information and such records shall be made available to an inspector whenever he so requests.

R.O.,c.70,s.28; 1960(2nd),c.5,s.4; 1967(1st),c.16,s.16.

Application

37. (1) This section applies only to

(a) a mine in which a shaft has been sunk to a depth of one hundred feet and stoping operations have been commenced; and

(b) any other mine that in the opinion of an inspector conducts operations that may require the use of mine rescue apparatus.

Mine rescue stations

(2) Mine rescue stations shall be established, equipped, operated and maintained at such places and in such manner as the Commissioner may direct.

Mine rescue superintendent

(3) A mine rescue superintendent is responsible for the maintenance of mine rescue equipment in good and serviceable condition at all times and for the operation of mine rescue stations.

Assessment of costs

(4) An inspector shall assess mines to which this section applies with the cost of maintenance of mine rescue equipment and with the cost of operation of mine rescue stations including the salaries of mine rescue superintendents.

Idem

(5) The assessment referred to in subsection (4) shall be made quarterly and shall be apportioned among the mines to which this section applies in the same proportion that

(a) the total number of man shifts worked underground and in the operation of the crusher, roaster, refinery, assay office and mill at the mine so assessed

is to

(b) the total number of man shifts worked underground and in the operation of crushers, roasters, refineries, assay offices and mills of all mines to which this section applies.

R.O.,c.70,s.29; 1967(1st),c.16,s.17.

Mine rescue training

38. (1) The manager of a mine shall cause sufficient personnel at the mine, including such proportion of the supervisory personnel as an inspector may direct, to be trained as mine rescue crews in the use and maintenance of mine rescue apparatus.

Idem

(2) Mine rescue crews shall be trained by a mine rescue superintendent in accordance with any direction given by an inspector.

Supervision of crews

(3) The manager of a mine shall supervise mine rescue crews in all mine rescue work and recovery operations conducted at the mine.

Returns

(4) The owner or manager of a mine shall submit to an inspector such returns or other information respecting safety at a mine or mine rescue training or operations as the Commissioner may prescribe.

R.O.,c.70,s.30; 1967(1st),c.16,s.18.

SECTION 3.5.1
UNITED KINGDOM

FIRE AND RESCUE

THE COAL AND OTHER MINES
(FIRE AND RESCUE) REGULATIONS 1956

S.I. 1956 No. 1768

Arrangement of Regulations

PART I. Application ... ... Reg. 1
PART II. Fire precautions and equipment ... ... Regs. 2 to 10
PART III. Precautions in case of outbreak or suspected outbreak of fire ... ... Reg. 11
PART IV. Rescue ... ... Regs. 12 to 37
PART V. Interpretation ... ... Reg. 38

PART I

Application

1. Except where otherwise expressly provided, Part II of these regulations shall apply to every mine of coal, stratified ironstone, shale or fireclay, Part III thereof to mines of those minerals in which or in part of which the use of lamps or lights, other than permitted lights, is unlawful, and Part IV thereof to every mine of coal, stratified ironstone, shale or fireclay, other than a mine at which not more than ten persons are employed below ground, and in these regulations 'mine' shall be construed accordingly.

PART II

Fire precautions and equipment

2. (1) No highly inflammable material shall be stored below ground in any mine except in a fireproof room, compartment or box.

(2) At any mine newly opened after the sixteenth day of December, nineteen hundred and eleven, being a mine at which more than thirty persons are employed below ground, no building or structure at the top of any shaft or outlet shall be made of or comprise any inflammable material likely to cause danger from fire to any person so employed.

(3) No engine-room or motor-room constructed after the sixteenth day of December, nineteen hundred and eleven, below ground in any mine shall be made of or comprise any inflammable material likely to cause danger from fire to any person employed in the mine

3. It shall be the duty of the manager of every mine to secure the provision of suitable and sufficient means of extinguishing fire at each of the following places, that is to say—

(*a*) at the top of and at every entrance to a shaft or outlet, being a place in the construction of which inflammable material is used;

(*b*) in every engine-room, motor-room or boiler gallery, being a place in the construction of which inflammable material is used; and

(*c*) at any place at which inflammable material is stored.

4. It shall be the duty of the manager of every mine to secure the provision and readiness for immediate use in case of fire of a sufficient supply of suitable dust or sand in suitable containers at an appropriate place in relation to every electric motor, which is not portable apparatus for the purposes of the Coal and Other Mines (Electricity) Regulations 1956*, transformer and switchgear installed at the mine.

5. It shall be the duty of the manager of every mine, other than a mine which is naturally wet throughout and at which not more than thirty persons are employed below ground or a mine of stratified ironstone, to secure the provision and readiness for immediate use in case of fire of—

(*a*) an adequate supply of water; or

(*b*) sufficient portable fire extinguishers and a sufficient supply of suitable dust or sand; and

(*c*) appropriate equipment for conveying and using the water, dust or sand in that case;

at appropriate places in relation to each working face and along any length of road below ground, being a length which is a main intake airway or a main return airway for the purposes of the Coal and Other Mines (Ventilation) Regulations 1956.†

6. (1) It shall be the duty of the manager of every mine, other than a mine at which less than one hundred persons are employed below ground, to secure the provision and readiness for immediate use in case of fire below ground of adequate supplies of water and efficient means for delivering it promptly at adequate pressure and in adequate volume to every place in the mine at which persons work otherwise than occasionally or for short periods or which persons going to or from their working places ordinarily pass, being in either case a place at which fire is liable to occur.

(2) Except in so far as provision is made in pursuance of the last preceding paragraph to deliver water through pipelines and hose extensions to every place at which it is required to be available, provision shall be made for delivery from tanks or barrels by portable manual pumps.

7. Where at any mine machinery for cutting or getting mineral is in use at a working face at which an ignition of gas has been, or having regard to the nature of the strata is liable to be, produced by such machinery, it shall be the duty of the manager to secure that—

(*a*) the machine is provided with effective means to prevent such ignition; or

(*b*) a portable fire extinguisher or supply of suitable dust or sand in a suitable container is carried on the machine; or

(*c*) if owing to the height of the working it is impracticable to carry such an extinguisher or such a container on the machine, portable fire extinguishers or supplies of suitable dust or sand in suitable containers are provided at suitable intervals along the face and at any point at which an airway, which as regards the face is an intake airway, meets the face.

8. No fire extinguisher which is liable when operated to give off poisonous gas shall be provided below ground whether in pursuance of these regulations or otherwise.

9. (1) It shall be the duty of the manager of every mine to make and ensure the efficient carrying out of arrangements—

(*a*) whereby all equipment provided in pursuance of this Part of these regulations is inspected by competent persons appointed by him at intervals not exceeding thirty days; and

(*b*) for the discharge and refilling of each fire extinguisher to ensure that it is maintained in good working order.

(2) Every person making such an inspection shall make a full and accurate report thereon to the manager in writing.

10. It shall be the duty of the manager of every mine, other than a mine at which less than one hundred persons are employed below ground, to make arrangements to secure a proper organisation of persons for combating any outbreak of fire and such arrangements shall include fire drills.

PART III[*]

[*] For application of this Part see Regulation 1.

Precautions in case of outbreak or suspected outbreak of fire

11. (1) Without prejudice to the generality of section seventy-nine of the Act if in any mine there appears any smoke or other sign indicating that a fire has or may have broken out below ground at any place, the persons in charge of any parts of the mine likely to be affected by such a fire, by products of combustion thereof or by any explosion resulting therefrom, shall cause all persons employed at any place likely to be so affected to leave it:

Provided that in any case in which it appears to the person in charge of the part of the mine from which that sign emanates that there exists no immediate danger persons may remain there for the purpose of preventing danger from arising.

(2) Where on any occasion persons have been caused to leave any place in pursuance of the provisions of the last preceding paragraph, no person shall thereafter be permitted to enter it until after examination thereof it is reported safe for him to do so either by the manager or an under-manager of the mine and by two members of the panel appointed for the mine under section one hundred and twenty-three of the Act or, if they do not concur, by an inspector:

Provided that nothing in this paragraph shall be taken to prohibit a person from entering any place for the purpose of saving life, ascertaining the condition of that place, ascertaining or taking any measures that it is necessary to take for the purpose of rendering it safe or ascertaining the effectiveness of such measures:

Provided also that the concurrence of two members of the said panel shall not be required if such persons are not available within a reasonable period after the manager or an under-manager of the mine has informed the person for the time being nominated to receive notices under subsection (1) of section one hundred and sixteen of the Act of the occurrence.

(3) Any report under the last preceding paragraph shall be a full and accurate report[*] signed by the persons making it and the position of the fire or suspected fire shall, if possible, be indicated by means of a plan. A copy of any such report shall forthwith be posted at the pithead.

(4) If on any occasion it is ascertained that fire has broken out at any place the following parts of the mine shall be deemed for the purposes of paragraph (1) of this regulation to be affected, that is to say, all parts of the seam in which the fire exists and all parts of any other seam reached from an entrance below ground to a shaft or outlet being an entrance from which the first mentioned seam is reached:

Provided that a part of the mine other than that in which the fire exists shall be deemed not to be affected if it is protected against the spread thereto of any explosion by means[†] approved by the Minister for the purposes of this regulation, and a seam other than that in which the fire exists shall be deemed not to be affected if it is naturally wet throughout.

(5) If on any occasion a fire is being dammed off all parts of the mine below ground shall be deemed for the purposes of paragraph (1) of this regulation to be affected, and until the work is completed no person shall be permitted to go below ground except for the purposes of that work or otherwise for securing the safety of the mine.

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[*] M. & Q. Form No. 261.

[†] No means for this purpose have yet been approved.

(6) If on any occasion it is ascertained that fire has broken out at any place measures shall be taken to render harmless any coal dust in accessible parts of the mine contiguous to the fire.

PART IV[‡]

Rescue

Central rescue stations

12. (1) It shall be the duty of the owner of every mine—

(*a*) to provide, maintain and conduct in accordance with the following provisions of this Part of these regulations a central rescue station to provide facilities for the conduct of operations for rescue and other necessary work at that mine after an explosion or a fire, or in an atmosphere which is or may be irrespirable, thereat; or

(*b*) to make arrangements to ensure that there are available to that mine such facilities provided by a central rescue station so maintained and conducted,

being a station situate within fifteen miles of the entrance to the mine or such greater distance not exceeding twenty miles as an inspector may authorise by notice served on the owner.

(2) An inspector may by notice served on the owner of a mine exempt him from the preceding provisions of this regulation with respect to that mine—

(*a*) if the inspector is satisfied that there are in force effective arrangements for the conduct of operations for rescue at that mine independently of a central rescue station; or

(*b*) if the mine is situate more than fifteen miles from such a central rescue station then existing and the inspector is satisfied that it would be unreasonable that the owner should be required to provide such a central rescue station; or

(*c*) if the inspector is satisfied that the owner has unsuccessfully made reasonable efforts to conclude such arrangements as are referred to in sub-paragraph (*b*) of the last preceding paragraph and that it would be unreasonable that he should be required to provide such a central rescue station.

(3) The owner of every mine to which paragraph (1) of this regulation applies shall ensure that it is in telephonic communication with the central rescue station the facilities of which are available to that mine.

(4) Without prejudice to the generality of section one hundred and seventy-six of the Act, to an authority or exemption given under this regulation there may be attached conditions requiring the provision at the mine of rescue equipment other than or in excess of that specified in these regulations.

Superintendents of and instructors at central rescue stations

13. (1) Every central rescue station shall be under the immediate control of a competent superintendent being a person who has been fully trained in rescue work and who, unless he was so employed before the first day of January, nineteen hundred and twenty-nine, has had not less than five years' practical experience of work below ground in a mine.

(2) There shall be employed at every central rescue station instructors competent to train rescue workers.

(3) Arrangements shall be made to ensure that an instructor is present at and appointed to take charge of a central rescue station at any time when the superintendent is not present thereat.

[‡] For application of this Part see Regulation 1.

(4) The number of instructors employed at a central rescue station at which a permanent rescue corps is maintained shall not be less than two, and, if the total number of persons employed below ground at the mines to which the facilities of that station are available exceeds fifteen thousand, shall not be less than three.

(5) The number of instructors employed at a central rescue station at which a permanent rescue corps is not maintained shall not be less than two, and, if the total number of rescue brigades required by these regulations to be maintained at the mines to which the facilities of that station are available exceeds fifty, shall not be less than three, and, if the total number of such rescue brigades exceeds one hundred, shall not be less than four.

(6) For the purposes of the two last preceding paragraphs, a superintendent who undertakes the training of rescue workers may be included as an instructor.

Permanent rescue corps

14. (1) At any central rescue station at which a permanent rescue corps is maintained that corps shall consist of not less than six men fully trained in rescue work exclusive of the superintendent and of the person appointed to take charge of the station when the superintendent is not present thereat.

(2) One or more members of the corps shall be trained to act as captain thereof.

(3) The members of the corps shall be continuously employed at and in residence at the central rescue station:

Provided that an inspector by notice served on the superintendent of the station may authorise members of the corps to reside not more than half a mile from the station so long as suitable means of summons from that residence to the station are provided.

Rescue workers to act with permanent rescue corps

15. (1) It shall be the duty of the manager of every mine at which not less than one hundred persons are employed below ground and to which the facilities of a central rescue station are available, being a station at which a permanent rescue corps is maintained, to appoint men who are employed at that mine and have a good general knowledge thereof and who have been fully trained in rescue work to co-operate with the corps in work and practice on the following scale, that is to say—

where not more than five hundred persons are employed below ground at the mine, not less than one man;

where more than five hundred but not more than one thousand persons are so employed, not less than two men;

where more than one thousand but not more than fifteen hundred persons are so employed, not less than three men;

where more than fifteen hundred persons are so employed, not less than four men.

(2) The manager of every mine to which the last preceding paragraph applies and at which more than one such man has been appointed, shall endeavour to ensure that at no time are they both or all employed below ground simultaneously otherwise than in rescue work or practice.

Rescue brigades

16. (1) It shall be the duty of the manager of every mine to which the facilities of a central rescue station are available, being a station at which a permanent

rescue corps is not maintained, to organise and maintain rescue brigades on the following scale, that is to say—

where not more than five hundred persons are employed below ground at the mine, not less than one brigade;

where more than five hundred but not more than two thousand persons are so employed, not less than two brigades;

where more than two thousand persons are so employed, three brigades:

Provided that—

(*a*) the preceding provisions of this paragraph shall not apply as respects a mine at which less than one hundred persons are employed below ground if arrangements are in force whereby a brigade from another mine will be made available promptly in case of need; and

(*b*) mines of which the surface entrances to all the shafts and outlets for the time being in use lie within a circle having a radius of two miles may be treated together as one mine if the managers have made arrangements therefor and served notice thereof on the inspector for the district.

(2) The manager of every mine to which this regulation applies shall appoint not less than five men fully trained in rescue work and employed at that mine to each brigade and shall appoint one of them captain.

(3) The manager of every mine to which this regulation applies shall endeavour to ensure that at no time are—

(*a*) in the case of a mine at which one rescue brigade is maintained, all the members of that brigade; or

(*b*) in the case of a mine at which more than one rescue brigade is maintained, members of both or all the brigades;

employed below ground simultaneously, otherwise than in rescue work or practice.

Communication with rescue workers

17. The manager of every mine to which either of the two last preceding regulations applies, shall make effective arrangements for summoning every person appointed thereunder from his residence in case of need.

Saving

18. In any prosecution for a contravention of regulation fifteen or regulation sixteen it shall be a defence to prove that the manager has made reasonable efforts to induce appropriate persons to be trained in rescue work and that the failure to comply fully was due to an insufficiency of persons able and willing to acquire the requisite qualification.

Qualifications of rescue workers

19. No person shall be selected for training in rescue work with a view to appointment as a member of a permanent rescue corps, as a rescue worker to co-operate at a mine with such a corps or as a member of a rescue brigade at a mine unless—

(*a*) he is certified by a registered medical practitioner after thorough examination to be fit to undertake rescue work and to be free from any organic disease or weakness;

(*b*) he has had not less than two years' practical experience of work below ground in a mine; and

(*c*) he is the holder of a certificate of proficiency in first aid granted by a society or body approved by the Minister for the purpose.

20. No person shall for the purposes of these regulations be deemed to be fully trained in rescue work unless he has attended one or more courses of instruction and practice therein at a central rescue station, being courses complying with a scheme approved† by the Minister, and has been certified by the superintendent of that station to be efficient and able to undertake rescue work with breathing apparatus.

21. No person shall be qualified to be appointed or to be a member of a permanent rescue corps, a rescue worker to co-operate at a mine with such a corps or a member of a rescue brigade at a mine unless he has within the last preceding twelve months—

(*a*) been certified by a registered medical practitioner after thorough examination to be fit to undertake rescue work and to be free from any organic disease or weakness; and

(*b*) attended a course of instruction and practice in rescue work, being a course including practices with breathing apparatus in a hot and irrespirable atmosphere and complying with a scheme approved by the Minister for such courses for maintaining efficiency.

Records at central rescue stations

22. There shall be kept at every central rescue station a record of every person attending a course of instruction and practice in rescue work thereat including the date and character of each practice and the condition of each man after each practice and, if anything abnormal is observed in the condition of any man, whether it is considered to be due to any defect in any apparatus used by him.

Equipment at central rescue stations

23. At every central rescue station there shall be provided and maintained in readiness for immediate use the following equipment, that is to say—

(*a*) twenty complete suits of breathing apparatus of a type approved by the Minister with means of supplying sufficient oxygen or liquid air to enable such apparatus to be used for forty-eight hours and means of charging such apparatus;

(*b*) four smoke helmets or other apparatus serving the same purpose, being helmets or apparatus of a type approved by the Minister, with not less than one hundred and twenty feet of tubing for each;

(*c*) four sets of reviving apparatus, not being apparatus of a forced breathing type, each with a cylinder or cylinders capable of supplying not less than twenty cubic feet of oxygen;

(*d*) a first aid box of a type approved by the Minister;

(*e*) twenty electric safety-lamps and six flame safety-lamps;

(*f*) cages of small birds for testing for noxious gas;

(*g*) a motor vehicle of adequate capacity;

(*h*) two portable signalling devices; and

(*i*) means for training persons to test for inflammable gas with a flame safety-lamp.

Rescue equipment at mines

24. It shall be the duty of the manager of every mine, other than a mine at which less than one hundred persons are employed below ground, to secure the provision and readiness for immediate use thereat of the following equipment, that is to say—

(*a*) a smoke helmet or other apparatus serving the same purpose, being a helmet or apparatus of a type approved by the Minister with not less than one hundred and twenty feet of tubing;

(*b*) a set of reviving apparatus, not being apparatus of a forced breathing type, with a cylinder or cylinders capable of supplying not less than twenty cubic feet of oxygen;

(*c*) one electric safety-lamp and one flame safety-lamp for each man fully trained in rescue work and employed at that mine; and

(*d*) two small birds for testing for noxious gas.

Breathing apparatus

25. (1) Subject to any exemption given by an inspector by notice served on the manager, breathing apparatus shall not be kept at any mine but shall be obtained as required for rescue work or training thereat from a central rescue station.

(2) Every suit of breathing apparatus kept at a central rescue station, or at a mine in pursuance of an exemption given under the last preceding paragraph, shall be adjusted and tested at the times and in the manner specified in the first schedule hereto and the results thereof shall be recorded in accordance with those provisions.

(3) No oxygen cylinder shall be used for re-charging breathing apparatus unless a part of the contents has been analysed and found to contain not less than ninety-eight per cent of oxygen. A record shall be kept of the result of every such analysis.

(4) No suit of breathing apparatus shall be used below ground in any mine unless as soon as may be before use it has been tested for leakage by immersion in the manner specified in the first schedule hereto and found safe except—

(*a*) upon a practice in air which is not irrespirable; or

(*b*) in a case in which subjection to such a test would prejudice an attempt to save life and the apparatus has been tested immediately before use for leakage by mouth suction.

(5) Without prejudice to the operation of sections one hundred and sixteen and one hundred and seventeen of the Act on the happening of any accident or occurrence at a mine likely to require the use of breathing apparatus, the manager shall inform by the quickest means available the inspector for the district and the person for the time being nominated to receive notices under subsection (1) of section one hundred and sixteen of the Act.

Signals for use in rescue work

26. In rescue work and training therefor the signals specified in the second schedule hereto and no other shall be used for the purposes specified in relation thereto.

Accommodation for rescue workers at mines

27. (1) It shall be the duty of the manager of every mine to secure the provision on the surface thereof of a suitable room with sufficient accommodation for any persons who may be engaged in rescue work or practice. That room shall be near to a shaft or outlet normally used by persons employed below ground at the mine and shall be adequately heated and lighted and kept clean and properly maintained.

(2) At every mine at which not less than one hundred persons are employed below ground the said room, if not permanently separated from accommodation used for any other purpose, shall be so arranged that it can readily be so separated. The equipment provided in pursuance of these regulations at that mine shall be kept therein.

(3) The manager of every mine shall appoint a responsible person to be in charge of the room provided in pursuance of this regulation.

Plans

28. It shall be the duty of the manager of every mine to keep at the mine or at such other place as may be approved by an inspector a sufficient number of sets of plans, in a form suitable for use by rescue workers, of the workings of the mine, so that at any time there are plans for each part of the mine showing clearly and accurately up to a date not more than three months past the extent of the workings, the airways and the direction of the air current therein and all principal doors, stoppings, air crossings and regulators and telephone stations by means of the signs specified in the third schedule hereto.

Inspection of equipment, &c.

29. It shall be the duty of the owner of every mine to which the facilities of a central rescue station are available to make arrangements for the inspection at intervals not exceeding six months by the superintendent of the station or an instructor nominated by him of the accommodation and equipment provided thereat for rescue work and training. Such arrangements shall ensure that on any such inspection the superintendent or his nominee shall be accompanied by an official of the mine and that any defect or deficiency disclosed thereby is promptly reported to the manager of the mine.

Provisions relating to conduct of rescue work

30. (1) It shall be the duty of the manager of every mine to make rules allotting to competent persons the duties to be performed by them on any occasion on which rescue work is about to be or is being carried out at that mine.

(2) Such rules shall include provisions to ensure that on any such occasion, at any time when the manager is not himself performing those functions, a competent person is in charge on the surface to secure that—

(*a*) no person enters any shaft or outlet for the purpose of going to a part of the mine affected, unless he is duly authorised so to do;

(*b*) the name of every person going below ground or returning above ground at the mine is recorded in writing;

(*c*) teams of rescue workers are organised and, where such a team is not a permanent rescue corps or a rescue brigade, a captain thereof is appointed;

(*d*) suits of breathing apparatus are tested in accordance with paragraph (4) of regulation twenty-five; and

(*e*) such other steps as can be taken on the surface to regulate and facilitate the rescue work are taken.

31. On any occasion on which rescue work is about to be or is being carried on in any mine, no person shall go below ground for the purpose of going to a part of the mine affected unless authorised so to do.

32. (1) On any occasion on which rescue work is about to be or is being carried on in any mine, no person shall be authorised to go below ground for any purpose which may involve the use of breathing apparatus unless he is a person for the time being qualified to be a member of a permanent rescue corps, a rescue worker to co-operate at a mine with such a corps or a member of a rescue brigade at a mine.

(2) On any such occasion no person shall be permitted to engage in a second or subsequent spell of work involving the use of breathing apparatus unless he has been medically examined since the preceding spell of work and is found fit to undertake it.

33. (1) On any occasion on which rescue work is to be carried out in a mine in an atmosphere which is or may be irrespirable, there shall be organised as soon as may be a base or bases (hereinafter referred to as a 'fresh air base') in respirable air but as near to the places in which the work has to be carried out as appears safe.

(2) Whenever any persons are engaged in rescue work beyond the fresh air base there shall, so far as is practicable, be stationed thereat—

(*a*) two persons including a person competent to test and maintain breathing apparatus and other rescue equipment and a person holding a certificate of proficiency in first aid granted by a society or body approved by the Minister for the purpose;

(*b*) a team of rescue workers ready for immediate service and equipped with breathing apparatus; and

(*c*) a set of reviving apparatus, a stretcher and a cage of birds.

(3) Telephonic communication shall, if practicable, be established and maintained between any fresh air base and the surface of the mine or an entrance below ground to a shaft or outlet.

34. (1) On any occasion on which rescue work is to be carried out in a mine, no team of rescue workers shall go beyond a fresh air base, or where an appropriate fresh air base has not been established shall go below ground, unless the captain has been given clear instructions where the team is to go and what it is to attempt by the person in charge at the fresh air base or on the surface, as the case may be, and if breathing apparatus is to be used, has assured himself that that apparatus has been tested in accordance with paragraph (4) of regulation twenty-five.

(2) Unless the captain of such a team is personally familiar with the route to be taken, he shall not proceed without a plan of the relevant part of the mine made in pursuance of regulation twenty-eight and on which that route is clearly marked.

35. (1) It shall be the duty of the captain of any rescue team engaged in rescue work in any mine to devote himself to the direction of the team and to secure its safety, and accordingly he shall not engage in manual work.

(2) Without prejudice to the generality of the foregoing, the captain of a team so engaged shall examine the state of the roof and sides of any place to be entered or passed by the team and he shall not permit the team to pass any place which appears to him insecure or except where it is necessary so to do in an attempt to save life to pass through any passage less than two feet high and three feet wide.

(3) If visibility is obscured by smoke, the captain of a rescue team shall secure that a life-line is taken in from the fresh air base or another place at which the air is respirable and that no member of the team moves out of reach of that line or, if that is not practicable, shall ensure that any road branching from a route is fenced off before the junction is passed.

(4) If visibility is not obscured by smoke, the captain of a rescue team when passing any junction shall see that the route is clearly indicated by means of arrows or other suitable marks.

36. The captain of any rescue team which is to use breathing apparatus in the course of any rescue work at any mine shall make sure that each such apparatus is working properly immediately before the team enters an atmosphere which is or may be irrespirable and shall in the case of such apparatus in which compressed oxygen is used read the pressure of oxygen at intervals not exceeding twenty minutes.

37. On any occasion on which a fire is being dammed off, there shall be kept available at or near the place two suits of breathing apparatus and persons qualified to use them under regulation thirty-two or two smoke helmets and persons competent to use them.

PART V

Interpretation

38. (1) In these regulations the following expressions have the meanings hereby respectively assigned to them, that is to say—

'the Act' means the Mines and Quarries Act 1954;

'fresh air base' has the meaning assigned thereto in regulation thirty-three;

'fully trained in rescue work' has the meaning assigned thereto in regulation twenty;

'mine' has the meaning assigned thereto in regulation one.

(2) The Interpretation Act 1889 shall apply to the interpretation of these regulations as it applies to the interpretation of an Act of Parliament.

FIRST SCHEDULE

(Regulation 25)

Adjustment and testing of breathing apparatus

1. In the case of breathing apparatus by which a uniform delivery of oxygen is provided, the reducing valve shall be so adjusted as to deliver not less than two litres of oxygen per minute.

2. A competent person shall as respects every suit of breathing apparatus at intervals not exceeding thirty days—

(*a*) thoroughly examine its general condition giving particular attention to any delicate or perishable part thereof;

(*b*) test it for leakage by complete immersion in water (other than of any liquid air pack which would thus be damaged) when fully distended under pressure and examine it closely for leakage;

(*c*) measure the pressure at which any automatic relief valve discharges;

(*d*) in the case of apparatus in which compressed oxygen is used, measure the pressure in the oxygen cylinder thereof; and

(*e*) in the case of such apparatus, measure by a flow meter the rate of delivery of oxygen and, in a case in which that rate can be adjusted by the wearer, measure that rate over the whole range of the adjustment.

3. No flow meter shall be used for the purposes of any test under the last preceding paragraph unless it has been tested for accuracy within the preceding six months.

4. No suit of breathing apparatus from which any leakage is found shall be deemed safe.

5. There shall be kept at every central rescue station, and at any mine at which any breathing apparatus is kept in pursuance of an exemption given by an inspector, a record of all tests carried out in pursuance of this schedule.

SECOND SCHEDULE

(Regulation 26)

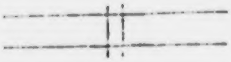
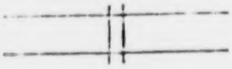
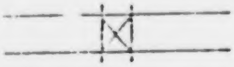
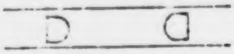
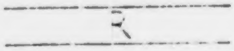
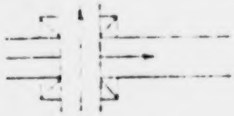
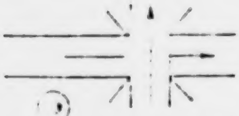
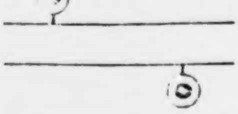
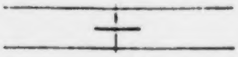
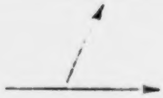
Code of Signals

Electric Signalling	Signal	Signalling between Members of a Brigade	Signal
'Distress' or 'Help wanted' .	ONE ring	'Distress' or 'Help wanted' .	ONE hoot
(If NO ANSWER is given to a call, 'Distress' is to be understood)			
'Not understood' or 'Repeat the Message'	TWO rings	Halt	TWO hoots
'No'	THREE rings	Retire	THREE hoots
'Yes' or 'All right' or 'All's well'	FOUR rings	Advance	FOUR hoots
To 'ring up'. To 'ring off' . .	FIVE rings	To call attention . . .	FIVE hoots

THIRD SCHEDULE

(Regulation 28)

Code of Signs

Brick, stone or concrete stoppings, constructed in the manner described in regulation 21 (2) of the Coal and Other Mines (Ventilation) Regulations 1956 . . .	
Brick, stone or concrete stoppings, other than the above	
Fire dams or seals	
Doors	
Regulators	
Air crossings, explosion proof	
Air crossings other than the above . . .	
Telephones	
Underground ambulance station (in red)	
Direction of air current →	

Intake airways—Blue. Return airways—Red.

APPROVED SPECIFICATIONS FOR THE PURPOSES OF THE COAL AND OTHER MINES (FIRE AND RESCUE) REGULATIONS 1956

Schemes for Instruction and Practices in Rescue Work

The schemes of instruction and practice in rescue work detailed below are approved for the purposes of regulations 20 and 21 (*b*):

Course of Initial Instruction and Practice (*Regulation 20*)

The course of instruction and practices shall be as follows:

(*a*) Instruction as to—

(i) the general methods of dealing with underground fires and the recovery of mines after fires and explosions;

(ii) the construction, use, repair, maintenance and testing of the type or types provided of breathing apparatus and of smoke helmets or other apparatus serving the same purpose;

(iii) the use of methods and apparatus of reviving men;

(iv) the properties and detection of the noxious and inflammable gases which may be found in mines;

(v) the taking of gas samples in irrespirable atmospheres;

(vi) the reading of mine plans;

(vii) the conduct of rescue work detailed in the said regulations and the code of signals contained in the second schedule to the said regulations.

(*b*) Practices—

Not less than 12 practices for each man with breathing apparatus and in addition not less than two for each man with smoke helmets or other apparatus serving the same purpose, in each case under conditions so devised as to represent those likely to be encountered in underground operations requiring the use of such apparatus.

The practices shall be carried out as follows:

(i) Rescue Brigades—as far as possible by each brigade as such, i.e., by all members of the brigade, at one and the same time.

(ii) Permanent Rescue Corps—by at least five members at one and the same time.

(iii) Men from Mines to act with Permanent Rescue Corps. Not more than eight men or less than five men shall take part in any part in any practice, but if five men do not attend on any occasion the number may be made up by members of the permanent rescue corps. So far as practicable the same five men shall practice together as one brigade.

(*c*) The practices with breathing apparatus shall take place in ordinary air and shall progress gradually until practices can be carried out in a hot and irrespirable atmosphere.

(*d*) The practices with breathing apparatus shall comprise the following operations:

(i) the repeated raising and lowering of a weight of 56lb. to and from a height of six feet by means of a rope and pulley;

(ii) walking continuously at a fair pace for half-an-hour;

(iii) building and removing temporary stoppings of stone, brick, sandbags, brattice cloth or other materials, and carrying the materials required for such operations over a distance of at least ten yards;

(iv) removing debris in confined spaces as representing the clearing of a fall of roof;

(v) setting timber or other roof supports;

(vi) carrying, pushing or pulling on a stretcher a live person or dummy body weighing 150lb. along the length of a gallery, and through an opening two feet high by three feet wide and four yards along;

(vii) the rapid establishment of communication.

All practices required by this part of this schedule shall last at least two hours except on occasion when, in the opinion of the instructor, it is desirable in the interests of safety to curtail the practice. At some of the practices the breathing apparatus shall be worn continuously for two hours.

Further Instruction and practice after initial training (Regulation 21 (b))

(*a*) Instruction

Revision of all subjects included in the course of instruction and practice specified in Part I of this Schedule.

(*b*) Practices

(i) Rescue Brigades and Men from Mines to act with Permanent Rescue Corps.—Practices with breathing apparatus at least one in each quarter and at least six in each year, of which at least two shall take place in mines, and the remainder in a hot and irrespirable atmosphere.

(ii) Permanent Rescue Corps.—In addition to regular practices at the Central Rescue Station, practices with breathing apparatus underground in a mine at least one in each quarter and at least six in each year. Members who are not employed regularly underground in mines shall have six further practices underground in mines each year, making 12 practices in all.

Where possible mine practices shall include work in low and constricted roadways.

All practices required by this part of this schedule shall last at least two hours except on occasion when, in the opinion of the instructor, it is desirable in the interests of safety to curtail the practice. At some of the practices the breathing apparatus shall be worn continuously for two hours.

FIRE AND RESCUE

First Aid Box

A first aid box containing equipment described below is approved for the purposes of Regulation 23(*d*):

1 set of splints
12 triangular bandages
24 roller bandages of various sizes
36 sterilised dressings of assorted sizes
2 rolls of cotton wool—1 lb. each
1 packet of surgical lint—1 lb.
2 rolls adhesive tape
1 eye bath
1 tube of suitable eye cream
6 tubes of antiseptic cream
2 small boxes of safety pins
1 pair of small scissors
1 tourniquet (one 2½" rubber bandage may be substituted).

SECTION 3.5.2
U.S. FEDERAL

code of federal regulations

Mineral Resources

30

Parts 0 to 199

Revised as of July 1, 1981

CONTAINING
A CODIFICATION OF DOCUMENTS
OF GENERAL APPLICABILITY
AND FUTURE EFFECT

AS OF JULY 1, 1981

With Ancillaries

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1934

PART 48—TRAINING AND RETRAINING OF MINERS

Subpart A—Training and Retraining of Underground Miners

Sec.
48.1 Scope.
48.2 Definitions.
48.3 Training plans; time of submission; where filed; information required; time for approval; method for disapproval; commencement of training; approval of instructors.
48.4 Cooperative training program.
48.5 Training of new miners; minimum courses of instruction; hours of instruction.
48.6 Training of newly employed experienced miners; minimum courses of instruction.
48.7 Training of miners assigned to a task in which they have had no previous experience; minimum courses of instruction.
48.8 Annual refresher training of miners; minimum courses of instruction; hours of instruction.
48.9 Records of training.
48.10 Compensation for training.
48.11 Hazard training.
48.12 Appeals procedures.

Subpart B—Training and Retraining of Miners Working at Surface Mines and Surface Areas of Underground Mines

48.21 Scope.
48.22 Definitions.
48.23 Training plans; time of submission; where filed; information required; time for approval; method for disapproval; commencement of training; approval of instructors.
48.24 Cooperative training program.
48.25 Training of new miners; minimum courses of instruction; hours of instruction.
48.26 Training of newly employed experienced miners; minimum courses of instruction.
48.27 Training of miners assigned to a task in which they have had no previous experience; minimum courses of instruction.
48.28 Annual refresher training of miners; minimum courses of instruction; hours of instruction.
48.29 Records of training.
48.30 Compensation for training.
48.31 Hazard training.
48.32 Appeals procedures.

AUTHORITY: Secs. 101 and 115 (a), (b) and (c) of the Federal Mine Safety and Health Act of 1977, Pub. L. 91-173 as amended by Pub. L. 95-164, 91 Stat. 1291, 1315-1316 (30 U.S.C. 811, 825 (a), (b), and (c)).

SOURCE: 43 FR 47459, Oct. 13, 1978; unless otherwise noted.

Subpart A—Training and Retraining of Underground Miners

§ 48.1 Scope.

The provisions of this Subpart A set forth the mandatory requirements for submitting and obtaining approval of programs for training and retraining miners working in underground mines. Requirements regarding compensation for training and retraining are also included. The requirements for training and retraining miners working at surface mines and surface areas of underground mines are set forth in Subpart B of this part.

Subpart B—Training and Retraining of Miners Working at Surface Mines and Surface Areas of Underground Mines

§ 48.21 Scope.

The provisions of this Subpart B set forth the mandatory requirements for submitting and obtaining approval of programs for training and retraining miners working at surface mines and surface areas of underground mines. Requirements regarding compensation for training and retraining are also included. The requirements for training and retraining miners working in underground mines are set forth in Subpart A of this part.

§ 48.4 Cooperative training program.

(a) An operator of a mine may conduct his own training programs, or may participate in training programs conducted by MSHA, or may participate in MSHA approved training programs conducted by State or other Federal agencies, or associations of mine operators, miners' representatives, other mine operators, private associations, or educational institutions.

(b) Each program and course of instruction shall be given by instructors who have been approved by MSHA to instruct in the courses which are given, and such courses and the training programs shall be adapted to the mining operations and practices existing at the mine and shall be approved by the Chief of the Training Center for the area in which the mine is located.

§ 48.5 Training of new miners; minimum courses of instruction; hours of instruction.

(a) Each new miner shall receive no less than 40 hours of training as prescribed in this section before such miner is assigned to work duties. Such training shall be conducted in conditions which as closely as practicable duplicate actual underground conditions, and approximately 8 hours of training shall be given at the minesite.

§ 48.6 Training of newly employed experienced miners; minimum courses of instruction.

(a) A newly employed experienced miner shall receive and complete training in the program of instruction prescribed in this section before such miner is assigned to work duties.

§ 48.8 Annual refresher training of miners; minimum courses of instruction; hours of instruction.

(a) Each miner shall receive a minimum of 8 hours of annual refresher training as prescribed in this section.

§ 48.3 Training plans: time of submission; where filed; information required; time for approval; method for disapproval; commencement of training; approval of instructors.

(a) Each operator of an underground mine shall have an MSHA approved plan containing programs for training new miners, training newly-employed experienced miners, training miners for new tasks, annual refresher training, and hazard training for miners as

§ 48.11 Hazard training.

(a) Operators shall provide to those miners, as defined in § 48.2(a)(2) (Definition of miner) of this Subpart A, a training program before such miners commence their work duties. This training program shall include the following instruction, which is applicable to the duties of such miners:

(1) Hazard recognition and avoidance;

(2) Emergency and evacuation procedures;

(3) Health and safety standards, safety rules, and safe working procedures;

(4) Self-rescue and respiratory devices; and

(5) Such other instruction as may be required by the Chief of the Training Center based on circumstances and conditions at the mine.

(b) Miners shall receive the instruction required by this section at least once every 12 months.

(2) *Self-rescue and respiratory devices.* The course shall include instruction and demonstration in the use, care, and maintenance of self-rescue and respiratory devices used at the mine. Such course shall be given before the new miner goes underground.

(3) *Entering and leaving the mine; transportation; communications.* The course shall include instruction on the procedures in effect for entering and leaving the mine; the check-in and checkout system in effect at the mine; the procedures for riding on and in mine conveyances; the controls in effect for the transportation of miners and materials; and the use of the mine communication systems, warning signals, and directional signs.

(4) *Introduction to the work environment.* The course shall include a visit and tour of the mine, or portions of the mine which are representative of the entire mine. A method of mining utilized at the mine shall be observed and explained.

(5) *Mine map; escapeways; emergency evacuation; barricading.* The course shall include a review of the mine map; the escapeway system; the escape, firefighting, and emergency evacuation plans in effect at the mine; and the location of abandoned areas. Also included shall be an introduction to the methods of barricading and the locations of the barricading materials, where applicable. The program of instruction for escapeways and emergency evacuation plans approved by the District Manager shall be used for this course.

(9) *Hazard recognition.* The course shall include the recognition and avoidance of hazards present in the mine, particularly any hazards related to explosives where explosives are used or stored at the mine.

(10) *Electrical hazards.* The course shall include recognition and avoidance of electrical hazards.

(11) *First aid.* The course shall include instruction in first aid methods acceptable to MSHA.

(12) *Mine gases.* The course shall include instruction in the detection and avoidance of hazards associated with mine gases.

PART 49—MINE RESCUE TEAMS

Sec.

49.1 Purpose and scope.
49.2 Availability of mine rescue teams.
49.3 Alternative mine rescue capability for small and remote mines.
49.4 Alternative mine rescue capability for special mining conditions.
49.5 Mine rescue station.
49.6 Equipment and maintenance requirements.
49.7 Physical requirements for mine rescue team.
49.8 Training for mine rescue teams.
49.9 Mine emergency notification plan.
49.10 Effective date.

AUTHORITY: Sec. 101, 103(h), 115(e) and 508 of the Federal Mine Safety and Health Act of 1977, Pub. L. 91-173, as amended by Pub. L. 95-164, 91 Stat. 1291, 1299, 1317, 83 Stat. 803 (30 U.S.C. 811, 813(h), 825(e), and 957).

SOURCE: 45 FR 47002, July 11, 1980, unless otherwise noted.

EFFECTIVE DATE NOTE: Part 49 becomes effective July 11, 1981.

§ 49.1 Purpose and scope.

This part implements the provisions of Section 115(e) of the Federal Mine Safety and Health Act of 1977. Every operator of an underground mine shall assure the availability of mine rescue capability for purposes of emergency rescue and recovery.

§ 49.2 Availability of mine rescue teams.

(a) Except where alternative compliance is permitted for small and remote mines (§ 49.3) or those mines operating under special mining conditions (§ 49.4), every operator of an underground mine shall:

(1) Establish at least two mine rescue teams which are available at all times when miners are underground; or

(2) Enter into an arrangement for mine rescue services which assures that at least two mine rescue teams are available at all times when miners are underground.

(b) Each mine rescue team shall consist of five members and one alternate, who are fully qualified, trained, and equipped for providing emergency mine rescue service.

(c) To be considered for membership on a mine rescue team, each person must have been employed in an underground mine for a minimum of one year within the past five years. For the purpose of mine rescue work only, miners who are employed on the surface but work regularly underground shall meet the experience requirement. The underground experience requirement is waived for those miners on a mine rescue team on the effective date of this rule.

(d) Each operator shall arrange, in advance, ground transportation for rescue teams and equipment to the mine or mines served.

(e) Upon the effective date of this part, the required rescue capability shall be present at all existing underground mines, upon initial excavation of a new underground mine entrance, or the re-opening of an existing underground mine.

(f) Except where alternative compliance is permitted under § 49.3 or § 49.4, no mine served by a mine rescue team shall be located more than two hours ground travel time from the mine rescue station with which the rescue team is associated.

(g) As used in this part, mine rescue teams shall be considered available where teams are capable presenting themselves at the mine site(s) within a reasonable time after notification of an occurrence which might require their services. Rescue team members will be considered available even though performing regular work duties or in an off-duty capacity. The requirement that mine rescue teams be available shall not apply when teams are participating in mine rescue contests or providing services to another mine.

(h) Each operator of an underground mine who provides rescue teams under this section shall send the District Manager a statement describing the mine's method of compliance with this part. The statement shall disclose whether the operator has independently provided mine rescue teams or entered into an agreement for the services of mine rescue teams. The name of the provider and the location of the services shall be included in the statement. A copy of the statement shall be posted at the mine for the miners' information. Where a miners' representative has been designated, the operator shall also provide the representative with a copy of the statement.

§ 49.3 Alternative mine rescue capability for small and remote mines.

(a) If an underground mine is small and remote, an operator may provide for an alternative mine rescue capability. For the purposes of this part only, consideration for small and remote shall be given where the total underground employment of the operator's mine and any surrounding mine(s) within two hours ground travel time of the operator's mine is less than 36.

(b) An application for alternative mine rescue capability shall be submitted to the District Manager for the district in which the mine is located for review and approval.

(c) Each application for an alternative mine rescue capability shall contain:

(1) The number of miners employed underground at the mine on each shift;

(2) The distances from the two nearest mine rescue stations;

(3) The total underground employment of mines within two hours ground travel time of the operator's mine;

(4) The operator's mine fire, ground, and roof control history;

(5) The operator's established escape and evacuation plan;

(6) A statement by the operator evaluating the usefulness of additional refuge chambers to supplement those which may exist;

(7) A statement by the operator as to the number of miners willing to serve on a mine rescue team;

(8) The operator's alternative plan for assuring that a suitable mine rescue capability is provided at all times when miners are underground; and

(9) Other relevant information about the operator's mine which may be requested by the District Manager.

(d) A copy of the operator's application shall be posted at the mine. Where a miners' representative has been designated, the operator shall also provide the representative with a copy of the application.

(e) In determining whether to approve an application for alternative compliance, the District Manager shall consider:

(1) The individual circumstances of the small and remote mine;

(2) Comments submitted by, or on behalf of, any affected miner; and

(3) Whether the alternative mine rescue plan provides a suitable rescue capability at the operator's mine.

(f) Where alternative compliance is approved by MSHA, the operator shall adopt the alternative plan and post a copy of the approved plan (with appropriate MSHA mine emergency telephone numbers) at the mine for the miners' information. Where a miners' representative has been designated, the operator shall also provide the representative with a copy of the approved plan.

(g) The operator shall notify the District Manager of any changed condition or factor materially affecting information submitted in the application for alternative mine rescue capability.

(h)(1) An approved plan for alternative mine rescue capability shall be subject to revocation or modification for cause by MSHA, where it is determined that a condition or factor has changed which would materially alter the operator's mine rescue capability. If such action is contemplated, the operator will be notified, and given an opportunity to be heard before the appropriate District Manager.

(2) If an application for alternative compliance is denied or revoked, the District Manager shall provide the reason for such denial or revocation in writing to the operator. The operator may appeal this decision in writing to the Administrator for Coal Mine Safety and Health or the Administrator for Metal and Nonmetal Mine Safety and Health, as appropriate.

4015 Wilson Boulevard, Arlington, Virginia 22203.

§ 49.4 Alternative mine rescue capability for special mining conditions.

(a) If an underground mine is operating under special mining conditions, the operator may provide an alternative mine rescue capability.

(b) An application for alternative mine rescue capability shall be submitted to the District Manager for the district in which the mine is located for review and approval.

(c) To be considered "operating under special mining conditions," the operator must show that all of the following conditions are present:

(1) The mine has multiple adits or entries;

(2) The mined substance is noncombustible and the mining atmosphere nonexplosive;

(3) There are multiple vehicular openings to all active mine areas, sufficient to allow fire and rescue vehicles full access to all parts of the mine in which miners work or travel;

(4) Roadways or other openings are not supported or lined with combustible materials;

(5) The mine shall not have a history of flammable-gas emission or accumulation, and the mined substance shall not have a history associated with flammable or toxic gas problems; and

(6) Any reported gas or oil well or exploratory drill hole shall be plugged to within 100 feet above and below the horizon of the ore body or seam.

(d) Each application shall contain:

(1) An explanation of the special mining conditions;

(2) The number of miners employed underground at the mine on each shift;

(3) The distances from the two nearest mine rescue stations;

(4) The operator's mine fire history;

(5) The operator's established escape and evacuation plan;

(6) The operator's alternative plan for assuring that a suitable mine rescue capability is provided at all times when miners are underground; and

(7) Other relevant information about the operator's mine which may be requested by the District Manager.

(e) A copy of the operator's application shall be posted at the mine. Where a miners' representative has been designated, the operator shall also provide the representative with a copy of the application.

(f) In determining whether to approve an application for alternative compliance, the District Manager shall consider:

(1) The individual circumstances of the mine operating under special mining conditions;

(2) Comments submitted by, or on behalf of, any affected miner; and

(3) Whether the alternative mine rescue plan provides a suitable rescue capability at the operator's mine.

(g) Where alternative compliance is approved by MSHA the operator shall adopt the alternative plan and post a copy of the approved plan (with appropriate MSHA mine emergency telephone numbers) at the mine for the miners' information. Where a miners' representative has been designated, the operator shall also provide the representative with a copy of the alternative plan.

(h) The operator shall notify the District Manager of any changed condition or factor materially affecting information submitted in the application for alternative mine rescue capability.

(i) (1) An approved plan for alternative mine rescue capability shall be subject be to revocation or modification by MSHA, where it is determined that a condition or factor has changed which would materially alter the operator's mine rescue capability. If such action is contemplated, the operator will be notified and given an opportunity to be heard before the appropriate District Manager.

(2) If an application for alternative compliance is denied or revoked, the District Manager shall provide the reason for such denial or revocation in writing to the operator. The operator may appeal this decision in writing to the Administrator for Coal Mine Safety and Health or the Administrator for Metal and Nonmetal Mine Safety and Health, as appropriate

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§ 49.5 Mine rescue station.

(a) Except where alternative compliance is permitted, every operator of an underground mine shall designate, in advance, the location of the mine rescue station serving the mine.

(b) Mine rescue stations are to provide a centralized storage location for rescue equipment. This centralized storage location may be either at the mine site, affiliated mines, or a separate mine rescue structure.

(c) Mine rescue stations shall provide a proper storage environment to assure equipment readiness for immediate use.

(d) Authorized representatives of the Secretary shall have the right of entry to inspect any designated mine rescue station.

§ 49.6 Equipment and maintenance requirements.

(a) Each mine rescue station shall be provided with at least the following equipment:

(1) Twelve self-contained oxygen breathing apparatus, each with a minimum of 2 hours capacity (approved under Subpart H of Part 11 of this title), and any necessary equipment for testing such breathing apparatus;

(2) A portable supply of liquid air, liquid oxygen, pressurized oxygen, oxygen generating or carbon dioxide absorbant chemicals, as applicable to the supplied breathing apparatus and sufficient to sustain each team for six hours while using the breathing apparatus during rescue operations;

(3) One extra oxygen bottle (fully charged) for every six self-contained compressed oxygen breathing apparatus;

(4) One oxygen pump or a cascading system, compatible with the supplied breathing apparatus;

(5) Twelve permissible cap lamps and a charging rack;

(6) Two gas detectors appropriate for each type of gas which may be encountered at the mines served;

(7) Two oxygen indicators or two flame safety lamps;

(8) One portable mine rescue communication system (approved under Part 23 of this title) or a sound-powered communication system. The wires or cable to the communication system shall be of sufficient tensile strength to be used as a manual communication system. These communication systems shall be at least 1,000 feet in length; and

(9) Necessary spare parts and tools for repairing the breathing apparatus and communication system.

(b) Mine rescue apparatus and equipment shall be maintained in a manner which will assure readiness for immediate use. A person trained in the use and care of breathing apparatus shall inspect and test the apparatus at intervals not exceeding 30 days. A record of inspections and tests shall be maintained at the mine rescue station for a period of one year.

§ 49.7 Physical requirements for mine rescue team.

(a) Each member of a mine rescue team shall be examined annually by a physician who shall certify that each person is physically fit to perform mine rescue and recovery work for prolonged periods under strenuous conditions. The first such physical examination shall be completed within 60 days prior to scheduled initial training. A team member requiring corrective eyeglasses will not be disqualified provided the eyeglasses can be worn securely within an approved facepiece.

(b) In determining whether a miner is physically capable of performing mine rescue duties, the physician shall take the following conditions into consideration:

(1) Seizure disorder;

(2) Perforated eardrum;

(3) Hearing loss without a hearing aid greater than 40 decibels at 40[illegible], 1,000 and 2,000 Hz;

(4) Repeated blood pressure (controlled or uncontrolled by medication) reading which exceeds 1[illegible] systolic, or 100 diastolic, or which is less than 1[illegible] systolic, or 60 diastolic;

(5) Distant visual acuity (without glasses) less than 20/50 Snellen scale in one eye, and 20/70 in the other;

(6) Heart disease;

(7) Hernia;

(8) Absence of a limb or hand; or

(9) Any other condition which the examining physician determines is relevant to the question of whether the miner is fit for rescue team service;

(c) The operator shall have MSHA Form 5000-3 certifying medical fitness completed and signed by the examining physician for each member of a mine rescue team. These forms shall be kept on file at the mine rescue station for a period of one year.

§ 49.8 Training for mine rescue teams.

(a) Prior to serving on a mine rescue team each member shall complete, at a minimum, an initial 20-hour course of instruction as prescribed by MSHA's Office of Education and Training, in the use, care, and maintenance of the type of breathing apparatus which will be used by the mine rescue team. The initial training requirement is waived for those miners on a mine rescue team on the effective date of this rule.

(b) Upon completion of the initial training, all team members shall receive at least 40 hours of refresher training annually. This training shall be given at least 4 hours each month, or for a period of 8 hours every two months. This training shall include:

(1) Sessions underground at least once each 6 months;

(2) The wearing and use of the breathing apparatus by team members for a period of at least two hours while under oxygen every two months;

(3) Where applicable, the use, care, capabilities, and limitations of auxiliary mine rescue equipment, or a different breathing apparatus;

(4) Advanced mine rescue training and procedures; as prescribed by MSHA's Office of Education and Training; and

(5) Mine map training and ventilation procedures.

(c) A mine rescue team member will be ineligible to serve on a team if more than 8 hours of training is missed during one year, unless additional training is received to make up for the time missed.

(d) The training courses required by this section shall be conducted by instructors who have been employed in an underground mine for a minimum of one year within the past five years, and who have received MSHA approval through:

(1) Completion of an MSHA or State approved instructor's training course and the program of instruction in the subject matter to be taught.

(2) Designation by the Office of Education and Training as approved instructors to teach specific courses, based on their qualifications and teaching experience. Previously approved instructors need not be re-designated to teach the approved courses as long as they have taught those courses within the 24 months prior to the effective date of this part. Where individuals are designated, the Office of Education and Training may waive the underground experience requirement.

(e) The Chief of the Training Center may revoke an instructor's approval for good cause. A written statement revoking the approval together with reasons for revocation shall be provided the instructor. The affected instructor may appeal the decision of the Training Center Chief by writing to the Director of Education and Training, MSHA, 4015 Wilson Boulevard, Arlington, Virginia 222[illegible]3. The Director of Education and Training shall issue a decision on the appeal.

(f) Upon request from the Office of Education and Training, MSHA, the operator shall provide information concerning the schedule of upcoming training.

(g) A record of training of each team member shall be on file at the mine rescue station for a period of one year.

§ 49.9 Mine emergency notification plan.

(a) Each underground mine shall have a mine rescue notification plan outlining the procedures to follow in notifying the mine rescue teams when there is an emergency that requires their services.

(b) A copy of the mine rescue notification plan shall be posted at the mine for the miners' information. Where a miners' representative has been designated, the operator shall also provide the representative with a copy of the plan.

§ 49.10

§ 49.10 Effective date.

All provisions and requirements of this part shall become effective on July 11, 1981.

SECTION 4.3
GREAT BRITAIN

REPORT ON A VISIT TO GT. BRITAIN (Feb. 1983)

Introduction

The visit was made by J. Amirault, P.Eng., for the purpose of investigating the British Mine Rescue organization and in particular to discuss the implementation of the mine rescue service in the National Coal Board. This included a visit to the N.C.B. Doncaster mine rescue station.

Mine Managers Scheme of Emergency Organization

The colliery manager must submit to the inspector for approval, a scheme of emergency organization which must be followed. An emergency event is termed an "Incident" and the situation is at once placed under the control of an "Incident Director", normally the mine manager. The mine manager is assisted in his duties by an "Incident Advisory Committee" comprised of senior technical personnel, a senior inspector, and representatives of the trade unions.

The foregoing represents the organizational practice which was recommended to be established under the 1926 committee report. The scheme of emergency organization provides for the assignment of various responsibilities and call out procedures. It regulates entry into the mine and details all relevant activity. The mandatory components of the emergency scheme are:

(i) authorization and registration of any person entering the mine during an emergency.
(ii) organization of rescue workers into teams.
(iii) servicing and testing of breathing apparatus.
(vi) medical examination of rescue workers.
(v) organization of both surface and underground operations
(vi) fresh-air base for underground rescue operations
(vii) systematic monitoring of environmental conditions

It is the role of the government inspectorate to approve the scheme, and to participate, where required with the overriding responsibility to minimize risk to mine site personnel.

The Mines Inspectorate regard the utilization of mine rescue teams using breathing apparatus as a last resort when dealing with mine emergencies. The Inspectorate is reluctant to have rescue teams enter an irrespirable atmosphere until alternative means of dealing with the situation are no longer possible. Nevertheless rescue teams are used from time to time as a standby precautionary measure. For example, a team may be standing by, with breathing apparatus donned - but without being "under oxygen" while miners without breathing apparatus are constructing a fire seal or as stopping. In short, the decision to use the rescue team in an irrespirable atmosphere is not one which the inspectorate allows to be taken without serious prior consideration. The entire process was described by C. Gorrie in a paper delivered at the Symposium on Mine Crisis held in Sydney Nova Scotia 1982. A photocopy of the paper has been included in this section (4.3), for your convenience.

National Coal Board Rescue Organization

The mine rescue service of the National Coal Board provides the principal emergency service to all coal mines in Great Britain and to a few private mines. There are 24 mine rescue stations operated by the Mines Rescue Service and organized into 6 districts under the heading of a General Manager located in Doncaster. Each station is headed by a district manager and has a four officers and up to fourteen (14) full time, permanent mine rescue men organized in brigades. In total, 300 persons are engaged full time to provide a National Mines Rescue Service supported by approximately 2500 part-time brigadesmen drawn from the various collieries.

Frequency of Incidents

The frequency of utilization of mine rescue teams is reported to be approximately 75 times per year on a national basis. Approximately one third of these incidents could be classified as emergency events with the remaining two thirds being classified as non emergency. Scheduled work in irrespirable atmospheres consists of checking and repairing stoppings, checking areas of spontaneous combustion, etc. One major event may be expected to occur once every 1 to 2 years.

Central Rescue Stations

Thirteen (13) "A" Class stations are operated and staffed with offices and permanent mine rescue men. In addition, each station is fully equipped to service mine rescue equipment and provide training sessions for new personnel. The training facilities are described later in this report.

Class "B" stations do not have any permanent rescue men assigned and normally serve as equipment supply and service centres, as well as training facilities for teams organized from the local collieries.

Station facilities are complemented by two specially fitted vans used to transport mine rescue workers and equipment from the station to the site of the emergency. Radio communication is maintained between the station, the vans and the "incident control rooms" using portable hand sets.

The NCB owns one large diameter drill rig capable of boring a 42" hole to a maximum depth of 500 metres for the purpose of reaching trapped miners. This equipment - Wirth L4 is of German manufacture and is under operational contract to a major British drilling contractor - Foraky. The drill rig is complemented by 5 portable winding engines which are trailer mounted for rapid road transport. By NCB policy, an area near the pit head is marked off and clear access is maintained to allow the emergency winder to be quickly installed for use. Similarly, all head frames are fitted with spare head sheaves for emergency purposes.

Liaison with other coal producing areas of Europe, principally Germany and France, is maintained via participation in the European Economic Commission (EEC) - Safety and Health Committee for the Mining and Extraction Industries. Relevant literature may be obtained through library facilities located at Luxenburg:

Commission of the European Committees
D.G. XIII - Directorate A
Bat. Jean Monnet, Plateau duKirchberg
Boite Postal 1907
Luxenburg

In addition there is close cooperation between the Technical heads of all similar, state operated, coal producing organizations within Europe.

Doncaster Mine Rescue Station

The Doncaster "A" Station is one of three mine rescue stations located within a 20 mile zone to provide service to 19 collieries, a central work shop, a NCB owned power station and one export terminal. This station was originally opened in 1913 and underwent major modifications in 1982 to both operational facilities and layout.

In its present form the facility provides adequate area for:

- administrative offices and lecture rooms
- VHF/UHF radio and telephone control room and paging system
- apparatus storage and assembly rooms
- oxygen clean room

- workshops
- training galleries with hot and humid atmosphere chambers
- dressing room, messroom and showers
- recreation room
- apparatus display room

Both the training galleries and the hot and humid (H & H) chambers are used as part of the training regime for both permanent and part time work. Specifications have been written to establish minimum fitness and performance levels. Exercise rooms, weight rooms and tread mills etc. are provided to assist the mine rescue workers in maintaining their fitness level on which their continued employment depends.

The training gallery is laid out to provide "near real" conditions to conduct specific training exercises for negotiating barriers and small openings, operating in smoke and darkness, transporting stretcher loads under realistic conditions, providing materials for the construction of barriers and seals, and in administering first-aid to the injured.

The Doncaster Station also provides a unique function of certification of self contained breathing apparatus on behalf of the Health and Safety Executive. All production units are tested on a mechanical lung with respect to function of specific key parameters (ie. temperature of operation, oxygen flow demand). Imported units have also been subjected to test routines and must meet minimum British Standards.

Emergency Call Procedure

All stations are organized on a priority basis. A particular station is on "first call" for those mines closest to the station and for which it has prime responsibility. It is on "second call" for the more distant mines. In this manner, no one station station is ever depleted of staffing when a second emergency arises. The permanent team responds fully equipped to an underground crisis and would assume the first tour of work. As the back up teams and the mine site teams are assembled, the permanent rescue team members are assigned control and supervisory functions, such as Fresh air base control and equipment inspection, to support the Mine Rescue operations which are being conducted by mine site teams.

In this manner an experienced team is always available to execute and administer Mine Rescue programs. This is particularly useful during times of crisis when the normal mine organization and practice may be suffering due to loss of staff.

Breathing Apparatus

Proto Mk IV

The most common breathing apparatus in use in the U.K. is the Proto Mark IV and the Aero Lox both manufactured by Siebe, Gorman & Co. Ltd. The Proto Mk IV is based on a design approved during the late 1930's.

This apparatus is very widely used and is capable of supplying a rescue worker with air for a period of more than two hours. It operates on the closed circuit principle, that is to say, the wearer's exhaled air has carbon dioxide removed by passing through a chemical absordent and is then replenished with oxygen and re-breathed. It consists of a cylinder of oxygen from which the breathing supply is drawn through a reducing valve, a breathing bag in which the exhaled air is purified, a cooler, breathing tubes, and a mouthpiece. When worn the oxygen cylinder is carried on the rescuer's back with the breathing bag in front of him. A reducing valve will automatically pass a regular (two litres) supply of oxygen per minute down the supply tube into the breathing bag, irrespective of the pressure in the cylinder. The reducing valve is fitted with an emergency or by-pass valve.

The mouthpiece is made from soft vulcanised indiarubber with a metal connecting-piece to the inhalation and exhalation tubes. It is shaped to fit comfortably between the lips and the gums and is completely gas-tight when properly adjusted. The nose-clip is made to close the nostrils of the wearer's nose.

The absorbent "Protosorb" is supplied in tins, each containing a charge of 4½ lb. The apparatus is supported on a broad belt strapped around the body. The bag is held in position while stooping or crawling by a belt passing through two loops at the back, and by a pair of shoulder braces with adjustable straps and buckles for further support.

Aerolox Liquid Oxygen Breathing Apparatus

The second major unit used within the U.K. is the Aerolox liquid oxygen breathing apparatus. The following technical description of the unit is drawn from published literature supported by Siebe Gorman in publications on mine rescue.

The Aerolox is a 3 hours, closed circuit, liquid oxygen breathing apparatus which provides cool, dry air even when being used in hot environment. Breathing resistance is so low that is is hardly noticeable under heavy work conditions. The rated duration of Aerolox is 3 hours with a 25% safety factor at hard work rate and a 6.5 lb. charge of liquid oxygen. As the work rate decreases, the duration increases.

Technical Work

Weight with liquid oxygen			32 lb falling to 26 lb	(13.4 kg) (11.8 kg)
Dimensions	-	length	19.5 in	(49.5 cm)
	-	width	15 in	(38.1 cm)

- depth	6.25 in (15.9 cm)
Liquid Oxygen Charge	6.5 lb (3 kg)
Absorbent Charge	3.5 lb (1.6 kg) of 6-10/mesh Protosorb (soda lime)
Oxygen flow	6-12 litres/minute

The heat from the purified air surrounding the liquid oxygen pack stimulates the evaporation of oxygen. The oxygen gas passes from the innermost container to and fro through the outer cases, and, by so doing, slows down heat input to liquid oxygen. As the cool gaseous oxygen flows out of the evaporating tube, it mixes with the purified air in the breathing bag, further reducing the air temperature and condensing more of the moisture. The condensate falls into the breathing bag where it remains trapped.

The Proto Mk IV and Aerolox have seen many years of extensive use and have been shown to be very functional and reliable. Discussions are now taking place with various manufacturers to design a new unit which would be lighter and more modern. While details of the new design are at present guarded, the NCB expect to licence a manufacturer to construct the new units within the near future.

Both the Proto Mark IV and the Aerolox unit are presently used with a mouth piece and nose clip to maintain the seal. A problem occurs when used under extremely hot conditions in that more facial skin is exposed. The NCB are investigating the application of full face masks with breathing apparatus. Such masks are not without concern in terms of maintaining the seal with the face. Even with positive oxygen pressure maintained within the mask, bad experiences have been noted when excess oxygen escapes from the mask and causes rapid ignition near the hair.

A more compelling reason to investigate a new unit is to standardize equipment. The use of two types of equipment requires two training regimes, two sets of spares and supplies etc. The NCB look forward to the day when the effort may be concentrated on one area, training and supply.

Other Equipment

Other equipment such as self rescuers, and type N masks, in mine rescue service, is similar to that used in Canada.

Communications

Incident control rooms are equipped with the standard NCB telephone set and a radio for contacting central rescue stations. Communication between Fresh air base and active teams is by a portable telephone system. Because the use of a mouth piece precludes verbal communication by the team members, response from the team is limited to signals of either yes or no. The team must be queried in such a manner to allow a yes or no answer. It is noted that this limitation to direct communication may cause frustration on the part of the team when responses are misinterpreted. The adoption of a full face mask would enable more complete communication to take place.

Candidate Selection & Training

Selection of voluntary candidates is performed in accordance with the provisions of the Act i.e.

a) medically fit
b) 2 years experience
c) First Aid certificate
d) completed a prescribed course in mine rescue.

All candidates must be between the ages of 21 and 45 and must comply with a certain standard of physical fitness. Assessments are on an annual basis.

Candidates meeting the above requirements must pass preliminary examination to ensure that they have a reasonable understanding of written communications. Following this, they may be selected to attend regular courses in mine rescue training.

The British Fire and Rescue Regulations 1956 (Appendix III Section 3.5.1) present the program used for instructing personnel training for the mine rescue work. All mines, including those of the N.C.B., are required to comply with them. The course is a combined lecture and practical training program given over a 16 day period. At the end of the training sessions, practical tests of an arduous nature are given and an oral test. Upon completion of the training program, the successful candidates are qualified to be mine rescue workers.

A program of on-going training and instruction is required by legislation in both the theoretical and practical aspects of mine rescue. Further training for the position of mine rescue officer is required to meet the demands of the Mine Qualifications Board. Selected candidates who have demonstrated leadership and management are permitted to attend further training to become mine rescue officers.

The training course is given by the NCB. Emphasis is on mining activities such as mining practice, ventilation, sinking, explosives, regulations etc. The courses are given one day per week over a 2 year period by professional instructors from mining technology institutions. The program is completed with two week intense course given by NCB personnel. They review the topics and assist the candidates in passing the examination set by the qualifications board.

Having obtained the necessary qualifications, the individuals are placed by NCB personnel into the positions of mine rescue officer and station superintendent. The strict regime of training, practice and examination ensure that all positions of responsibility are filled by competent and seasoned personnel.

Organization of Teams

(At the mines) Mine rescue teams are organized into 5 man teams under a captain. All personnel are trained with respect to mine rescue functions, however, some effort is made to ensure that a variety of personnel such as engineers, ventilation technicians, mechanics, electricians etc. are present on each team. Furthermore, mine rescue personnel are scheduled so that not all team members are underground at the same time. This ensures that the mine rescue system and brigade corps are available at times of need.

NCB policy dictates that each team member must pass a medical examination prior to each tour of duty underground. Past experience has shown that excessive duty schedules may result in psychological stress that may have damaging effects on individual team members, and upon the entire team.

Some recovery operations last for many weeks and strict limits are placed upon exposure hours by team members. At the first sign of undue stress, team members are relieved from active service and are not recalled until after adequate rest time has beent set. Such practices are possible due to the large numbers of trained men available for duty.

Remuneration

Renumeration for the permanent mine rescue workers is established by contract with the respective trade union. Since this is a full time position, no other provisions are made for special job duties.

For the part time mine rescue worker, special pay considerations take into account the danger and loss of freedom aspects associated with mine rescue work. The essence of these special arrangements is given below with associated current rates.

	L	$
(a) mine rescue workers annual allowance	55	100
(b) training and rescue operations differential paid while in transit and standby mode, per hour	1.20	
(c) shift differentials	Various	
(d) special rate for Saturday & Sunday, per shift	72	130

Mock Emergencies and Rescue Competitions

It is current NCB policy to utilize Mock Emergencies at least once per year to test the efficiency of the organizational arrangements. From the time the emergency is declared, all persons required to staff the necessary components of the rescue operation, such as the mine management, central rescue station medical service, security and mine inspector are contacted. Area management and national headquarters are notified as part of the call out.

Mine rescue competitions are used to sharpen personnel skills for real emergencies. Competitions are held annually and consist of an oral examination, followed by a practical exercise under simulated conditions of heat, humidity or smoke. The performance of the teams is judged by a panel selected from the mine and mine rescue management.

Acknowledgement

The writer wishes to acknowledge the assistance of those persons in the United Kingdom listed over leaf who assisted in the compilation and assessment of the data on mine rescue programming.

Officials of the National Coal Board and British Mining Consultants Ltd. were most helpful in meetings and in the provision of documentation.

Private communication between the writer and the Health and Safety executive served to reinforce and enlarge upon ideas expressed in presentation to the Mine Crisis Seminar held in Sydney, N.S. during the fall of 1982.

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INTERNATIONAL SYMPOSIUM ON CRISIS MANAGEMENT
(Mine Fires, Explosions and other Emergencies)
Sydney, Nova Scotia, Canada, October 19-21, 1982

Mine Crisis Management and Inspectorate Involvement in the United Kingdom

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Summary:

The historical development of mine crisis management procedure in the United Kingdom is described as a background to current practice with the applications during the inundation at Lofthouse Mine and, more recently, during the explosion at Cardowan Mine being used to demonstrate the wide ranging nature of the problems encountered. The close technical involvement of HM Inspectorate of Mines and the mandatory controls over rescue and recovery operations then lead into a description of the style of investigation, report and consultation normally adopted after a serious mining accident in the United Kingdom.

MINE CRISIS MANAGEMENT AND INSPECTORATE INVOLVEMENT IN THE UNITED KINGDOM

1 Introduction

The general framework of mine crisis management procedure in the United Kingdom was formed by a Departmental Committee on Mine Rescue Work appointed to enquire into and make recommendations on all aspects of rescue work in mines, which reported in 1926 [1] *. As a result mining safety legislation was laid down which still provides the main basis for the present regulations covering mine crisis management [2]. The twin objectives of these regulations are to ensure that every mine is provided with a skilled mines rescue service and that on any occasion where rescue operations have to be instigated, there is also an efficient organisation to ensure that the rescue operations are conducted with the minimum of risk. There has been little change in this basic structure over the course of half a century which might suggest lack of progress but, on the contrary, a close examination of the subject reveals the perception and skill which the Committee applied to their work.

Unfortunately, the history of coalmining has been fraught with disaster and there has been ample opportunity in which to test and try the mechanisms of mine crisis management. Mistakes have been made and lessons learned with the experience so gained leading to procedures which have been honed to a very fine edge. The specific arrangements for mine crisis management are encapsulated in the "Scheme of Emergency Organisation" which the National Coal Board require a mine manager to prepare. This meets his statutory obligation under mining safety legislation which allows a measure of flexibility but also imposes a number of mandatory requirements which are common to all schemes. Legislation notwithstanding, the view of most mining engineers in the United Kingdom is that mine crisis management arrangements depend for their efficiency on the successful marriage of two very highly developed skills, namely, that of a specialist rescue service with a highly professional management team. Like any successful marriage, however, it benefits from free and full cooperation and consultation with the rest of the family, in this case the Trade Unions and HM Inspectorate of Mines who, although each having their separate roles in a mine crisis, all share the same common objectives.

Choosing a case study which portrays the full picture of mine crisis management in the United Kingdom is more difficult. There has certainly been no lack of disasters from which to choose but the dissimilarity between separate incidents ranges widely. For this reason, reference will be made to two separate incidents, one being the crisis following an underground inrush of water at Lofthouse Mine in 1973 [3], where the mine crisis management organisation was exposed to the full spotlight of world attention for over a week, and the other, the incident at Cardowan Colliery earlier this year [4], where 41 workmen

* [ ] References listed at end of paper

involved in an underground firedamp explosion were all rescued without loss of life. Lack of space permits only the briefest descriptions because it is considered that a more important aim of the Symposium is a study of the details of the scheme of emergency organisation, how it was developed and how it works in practice.

It would be remiss of the Author, as a member of HM Inspector of Mines, not to refer to the special role of that Inspectorate in mine crisis management. By far their heaviest involvement is in the subsequent investigation, report, and recommendations which inevitably follow any serious mining accident but there are sound reasons for their technical involvement in rescue and recovery operations during any mine crisis.

2 Evolution of Emergency Organisation at Mines in the United Kingdom

When considering the degree of hazard facing any rescue worker entering an irrespirable atmosphere in the wholly hostile underground environment likely to be encountered after an explosion, in the highly charged emotional state associated with serious casualties and, certainly not least, in the sheer physical discomfort of wearing a self-contained breathing apparatus in confined spaces while carrying out arduous work, it is truly remarkable that this type of work which is promulgated to save life, can itself be carried on without resulting in serious loss of life. Undoubtedly, there have been serious accidents during rescue operations, often for no other accountable reason than psychological strain, but the overall performance of rescue work in the United Kingdom mines since the 1926 Rescue Committee Report must be recognised as one of outstanding achievement when considered in relation to the risks which are involved. Such standards can only be achieved where the levels of knowledge and skill of the rescue personnel, the standard of their rescue equipment and the discipline of their service are all of the highest order.

The 1926 Rescue Committee had been faced by many serious problems in the conduct of rescue work preceding its deliberations and they decided that the only real answer for the United Kingdom mining industry lay in the provision of a Central Mines Rescue Service. Accordingly, they recommended that new legislation should make it mandatory for a mine to be linked to a Central Mines Rescue Station and this was the first major step in the establishment of the present Central Mines Rescue Service.

Due cognisance had also to be taken of the fact that when rescue operations were to be mounted at a mine, serious hazards would arise unless these operations were very carefully organised and controlled by a senior level of management. In consequence, the formulation of emergency management procedures which must be followed during any rescue operation were seen as an essential adjunct to the provision of a rescue service. The general statutory requirements relating to mine crisis management and rescue operations are illustrated in the orbital diagram at Fig. 1. Arrangements relating to the provision of an efficient rescue service, and the other requirements on strict management control, are both seen to lead to the common objective of the safe conduct of rescue operations. Subsequent reference will be made to each aspect of the organisation shown on the diagram in the text of the paper.

Because high standards of maintenance of equipment and of supervision are of such importance to the operational safety of rescue operations, certain requirements have been laid down in statute. These requirements are also illustrated in an orbital diagram at Fig. 2. They are based on the concept of the Central Mines Rescue Station at the core, its own management structure, the training of rescue personnel and the provision of facilities for the safe conduct of rescue operations under the direction of management at the mine. Two types of rescue organisation are permitted in the United Kingdom and management can opt for either by local agreement binding management in the locality to the preferred arrangements. In Scheme "A", a rescue corps is maintained in permanent residence at the Central Rescue Station. Scheme "B" does not have a permanent corps. Both schemes invite volunteers at each mine to train in rescue work but in scheme "B" the numbers required and the intensity and frequency of their training is necessarily greater than in Scheme "A". On the choice of rescue service so offered, it must be said that the speed at which a rescue operation using breathing apparatus can be mounted depends largely on the speed at which a fully equipped rescue team can be assembled ready to descend the mine. On speed alone, therefore, the preference in this respect would be for the Scheme "A" Rescue Station with its permanent corps, since under Scheme "B" arrangements, rescue team members may be dispersed throughout the mine or may have to be summoned from home. For local knowledge of the mine, however, rescue brigades from the mines concerned would usually carry some advantage.

3 Prolonged Mine Crisis at Lofthouse Colliery

At 2.00 a.m. on 21st March 1973, as a team of coalface workers was shearing through a narrow longwall coalface about 200 metres depth from the surface at Lofthouse Colliery in the Yorkshire Coalfield, an inrush of water occurred which focused world attention on the mine for eight days, as a dramatic race against time began in the efforts to rescue seven workmen who were trapped.

As underground officials and workmen withdrew from the vicinity of the affected face, the alarm was raised at the surface and the scheme of emergency organisation activated. A call was sent to Wakefield Central Mines Rescue Station some 8 kilometres distance from the mine and by the time the permanent rescue corps had arrived, it was established that a number of workmen employed on the coalface were still missing. A rescue effort was immediately mounted to try and find them but both roadways providing access to the coalface were found to be sealed by flooding at a distance of about one kilometre back from the face.

Meanwhile, an inspection made of the surface area in the general location of the coalface revealed the collapse of surface ground around some old shafts and it was then clearly evident that an inundation of considerable magnitude had occurred from old uncharted workings.

After assessing the results of the first inspections by rescue teams, a group of senior management who had been quickly assembled at the surface of the mine, decided that the action which had already been taken to start installing pumping equipment to clear the flood water blocking the access roads to the face, should be supplemented by a simultaneous action to:

(i) drill a borehole from the surface into the district

(ii) block the inflow of any further water into the coalface from the surface by sealing the old shafts which had been exposed in the collapse of the surface

(iii) drive a small "piggy-back roadway" over the swilly causing the blockage

(iv) explore the possibility of a rescue team experienced in sub-aqua work to pass through the water and sludge blocking the roadways.

In the event, pumping of the semi-solids and sludge causing the blockage proved impracticable with the pumps which were readily available. Similarly, attempts by the sub-aqua mines rescue teams to pass through the sludge likewise proved completely impossible and the only recourse left in the rescue effort was to proceed as quickly as possible with the "piggy-back" drivage over the blockage. Needless to say, this became a highly charged and emotional race against time, with miners who were close relatives of those trapped being involved and achieving almost superhuman feats of drivage with the intervening distance of some 60 metres being completed in just over 2 days. Thereafter, rescue teams were able to pass through the blockage and proceed forward in chest-deep sludge wearing breathing apparatus. With the ventilation blocked, however, firedamp had built up to dangerous levels and drilling from the surface was stopped short of holing into the district for fear of ignition. As subsequent rescue teams progressively worked their way forward, the atmosphere became increasingly irrespirable and when the roadway was again found to be blocked nearer to the face, all hope of rescue of the trapped workmen alive had to be abandoned.

The rescue effort was eventually concluded some eight days after it had started. As can be well imagined of any such setting exposed to the full glare of public attention, compounded as it was by the extremely arduous nature of the underground conditions, and with every decision to be made involving some element of risk, officials in charge of the rescue operations and senior members of HM Inspectorate who had been present throughout the incident were placed under severe stress as was the scheme of emergency organisation itself. The relatives of those workmen trapped and the public at large had the right to be kept fully briefed on what was happening and reassured that every step which reasonably could be taken was in fact being taken. In this respect the level of public accountability could not have been higher. Balanced against the obvious public pressure to make the rescue attempt was the safety of the rescuers themselves and eventually of the rescue teams pressing forward under the most arduous circumstances in an irrespirable atmosphere. Doomed as the rescue attempt was to failure, however, what the operation did demonstrate quite conclusively was that the Scheme of Emergency Organisation could cope with most severe type of mine crisis by meeting the demands of the situation and yet also ensuring the safety of all involved.

4 Successful Rescue Operation at Cardowan Colliery

In contrast to the Lofthouse Colliery inundation, the explosion at Cardowan Colliery on 27th January, 1982 was chosen as a second case study because of the outstanding success of the rescue operation, namely, that all 41 workmen who were involved in a substantial underground explosion of firedamp were rescued without loss of life from a longwall coalface in a narrow seam some 5 kilometres from the shaft bottom. The explosion occurred during a morning production shift when a plug of firedamp was accidentally blown out of a gas-fast heading into the main intake airstream to the coalface where it was ignited by a frictional sparking at the shearer drum. The scheme of emergency organisation for the mine was immediately activated when the lamproom attendant at the surface received a telephone call directly from the coalface at 8.57 a.m. The Central Mines Rescue Station at Coatbridge, some 10 kilometres distance from the mine, was then notified and its permanent rescue corps arrived at 9.10 a.m. ready to go underground wearing breathing apparatus.

During the course of rescue operations it was quickly established that re-entry into the district was safe and all available officials and workmen who were underground at the time were deployed to the assistance and recovery of the injured workmen. As a result, the last of the injured workmen had been rescued from the coalface, transported the 5 kilometres to the shafts, brought out of the mine and taken to hospital where they were undergoing intensive treatment within 2 hours 40 minutes of the explosion having occurred. It is one of the enigmas of safety engineering that there is no way of measuring the efficiency of such an operation in the number of lives which were saved. What is not in doubt in this case, however, is that the speed with which the emergency was raised, the use of self-rescuers, the rapid deployment of first-aid and medical services and the short period elapsing before the seriously injured were undergoing medical care in hospital, did in fact save lives.

In terms of the types of mine crisis to be managed there could indeed be no stronger contrast between the Cardowan and Lofthouse incidents. At Cardowan the explosion was over in seconds and, although injured and dazed by the explosion, an official was able to go to the telephone and raise the alarm. All workmen were equipped with self-rescuers allowing not only self-rescue but also to aid the rescue of others. The prompt activation of the scheme of emergency organisation ensured the participation of all services and strict control over the total operation from its very start. In short, the organisation functioned exactly as intended and the crisis, as such, was virtually over shortly after it had begun. At Lofthouse the incident required a sustained rescue effort of the most arduous and hazardous nature over a prolonged period where there was very serious concern about the safety of the rescue workers.

5 Mine Manager's Scheme of Emergency Organisation in the United Kingdom

The general arrangements for control procedures adopted during emergencies at mines of the National Coal Board in the United Kingdom are illustrated at Fig. 3. Central to all control procedures is the mine manager's scheme of emergency organisation which is drafted to meet the manager's statutory duty under the rescue regulations that he should ".... make rules allotting to competent persons the duties to be performed by them on any occasion on which rescue work is about to be carried out ....". The regulations go on to make further provision regarding rescue arrangements but relative to statutory requirements governing the management structure of the mining industry in the United Kingdom, the mine manager would exert general direction over the rescue operations as the Incident Director and would usually be advised by senior mining engineers, including experts in the specialist subjects involved as well as a Senior member of the Inspectorate.

The nerve centre of the organisation is the Central Control Room where a detailed log of all instructions, actions and other relevant information is kept by Controllers of Senior Managerial status who would be present round the clock and would be charged with the responsibility of implementing the Incident Director's instructions of which the following requirements are mandatory:

(i) Authorisation and registration of any person entering the mine during the emergency

Persons authorised to go underground would be issued with an envelope with three similarly numbered but differently coloured tabs, the first of which would be exchanged for a lamp in the lamp room, the second given to the banksman on proceeding underground and the third to be retained on the person while below ground. The process is reversed on coming out of the mine with the tabs being collected and returned to the underground control room.

(ii) Organisation of rescue workers into teams

This duty would normally be delegated to the rescue station superintendent and discharged through his Rescue Station Instructors. Since the logistics of a large rescue operation require careful organisation with teams of fully trained part-time rescue workers being brought in from other mines, a separate rescue operational control room should be provided to allow close control over the organisation of the teams and their briefing prior to descending the mine. Equally important is their later debriefing on returning to the surface with appropriate records being kept of their work and reports.

(iii) Servicing and Testing of Breathing Apparatus

The arrangements for servicing and testing rescue apparatus prior to its re-use would be decided by the rescue station. In this respect a detailed specification for a surface rescue room has been prepared as a guide for mines in the United Kingdom which should meet even the most extreme exigencies and allow all servicing to be carried out at the mine surface under the direction of the rescue controller. A suitable layout is illustrated at Fig. 4.

(iv) Medical Examination of Rescue Workers

The Rescue Regulations require medical examination of rescue personnel during their involvemnt in an emergency and a place with suitable facilities must be provided for this purpose but the duties of medical officers in a mine emergency range much wider, especially at the outset in circumstances where a number of casualties have been experienced.

(v) Organisation of both surface and underground operations

Separate control rooms are normally provided for both surface and underground operations with the specific task of organising and managing the detailed implementation of the Incident Director's operational instructions. The deployment of manpower and other resources in this sphere of operations usually requires supervision by persons experienced in management.

(vi) Fresh-Air base for underground rescue operations

This is the final link with the rescue team prior to it entering an irrespirable atmosphere and the regulations are quite precise in their requirements as to control and facilities at this point. Other than for the purpose of saving life, a rescue team would not proceed beyond the Fresh-Air Base unless a stand-by rescue team was available and experienced rescue instructors present with suitable first-aid and reviving equipment provided. To ensure adequate control, an efficient communication system must be quickly established between this rescue control point and the incident control room.

(vii) Systematic monitoring of environmental conditions

The main purpose of environmental monitoring during any mine crisis is to ensure that the Incident Director has sufficient information to safeguard those engaged in underground rescue and recovery operations. In the schemes of emergency organisation used in the United Kingdom, the control procedure involves fixing underground locations where systematic monitoring will be carried out usually with hand held instruments but backed up with the collection of air samples for full gas analysis to correlate with the instruments. The results are carefully logged and charted in the central control room and the Incident Director immediately informed of any adverse trends by the Incident Room Controllers.

Of paramount importance to any such emergency and its management is the process of deciding policy and the overall action programme to be followed. In a complex underground incident, and history has shown that there are very few such incidents which are not complex, the range of expertise and experience required to ensure a safe and efficient operation is often outside the scope of any individual. A wide range of specialist advice will usually be required and normal practice at mines in the United Kingdom is for the most senior engineers available to form an advisory committee which will keep the whole operation under review and advise the Incident Director on any action action which they consider should be taken. Needless to say, the structure of the Committee will depend on the type of incident and expertise required but it could be expected to cover all matters associated with the incident from the staffing of the control rooms at the outset, right through to the ultimate lifting of the emergency.

6 The Role of the Government Inspectorate During Mine Rescue and Recovery Work in the United Kingdom

Reference has already been made to a mine manager's statutory duties to set up a scheme of emergency organisation but it is also obligatory that when the scheme is activated, because of either a serious accident or of rescue operations being initiated, that HM Inspectorate of Mines must be notified by the quickest means available. There are strong historical reasons for this involvement which may be peculiar to the United Kingdom and which may be outside the remit of this Symposium but in order to be eligible for appointment as HM Inspector of Mines, a mining engineer must not only hold the relevant statutory qualifications for mine management but is also required to have at least two years experience in mine management. The clear intention of the regulations is that this managerial experience and expertise of the Inspectorate must be involved during any rescue operations. This part of the paper describes the specific role of HM Inspectors in the overall organisation of mines crises and his relationship with both management and workers in this respect.

When called to any such incident an Inspector's primary concern would be that of all other senior mining engineers in attendance, namely, to ensure that all possible steps have been taken to save life, succour the injured and safeguard those engaged in rescue operations. This may amount to no more than ensuring that there is an emergency scheme of organisation and that it is working, but simple as this may sound, the traumatic effect of a mine crisis involving serious casualties many of whom are possibly well known to officials at the mine, can have a devastating effect on any organisation. During these early stages, an Inspector will seek to ensure that the rescue teams are properly directed on to the job, that the evacuation of the mine by non-rescue personnel is taking place and that a careful check is being kept of possible casualties.

Thereafter, the Inspector has specific duties which are closely linked to those of management but are nonetheless completely separate. In the United Kingdom, the Minister involved would normally make a statement to the House of Commons on which Members of Parliament could question the Minister in some depth on any related matters, and in consequence a full briefing would normally be required. The provision of this information would be the responsibility of the local Senior Inspector through the Chief Inspector. In the implementation of his own organisation, therefore, the Senior Inspector in the field would initially be concerned with both the input from an experienced Inspector into the crisis to ensure its orderly progress and thereafter the outflow of information on that progress. To achieve both objectives, he would wish an experienced Inspector to be in close touch with the Incident Control Room on a round the clock basis. This Inspector would be primarily charged with keeping a watching brief over the implementation of the whole operation, that any untoward developments which arise are quickly remedied and generally to assist in the smooth operation of the emergency organisation as required.

In the conduct of underground rescue operations, the Senior Inspector must also bear in mind that a primary objective of the whole scheme of emergency organisation is to ensure the safety of those engaged in the rescue operation. Reference has already been made to the Fresh-Air base and to the need to stipulate the staffing and equipment at this point in legislation. The reason for this level of priority is that where any mishap occurs in a rescue operation, it usually occurs at the cutting edge where the rescue operations are in fact being carried out. It comes without warning and if life is to be saved it will usually involve some form of reflex action. The needs of this type of situation warrants the presence of an Inspector and since this is the place of work where Inspectors have lost their lives or have been seriously injured they need no reminding that this is the place where the whole operation is most vulnerable.

On matters of policy relating to the conduct of both rescue and recovery operations, experience has shown that this is an area where close liaison must be maintained between management and the Inspectorate. The place to do this is in the Mine Crisis Advisory Committee where the detailed planning of the operation will be carried out and in this respect the Senior Inspector will require to be briefed in detail on the policy which is proposed. Leading from this liaison is the duty placed on the Inspectorate by law in the United Kingdom, that the Inspectorate must keep representatives of the Trades Unions fully informed of any matters affecting their safety. Where necessary, the Inspectorate would be obliged to conduct separate discussions with the Unions but the preference by far in an emergency situation would be to see this need fulfilled in the context of full cooperation and consultation between management and the workforce. In the United Kingdom, it is normal practice for senior representatives of the Trade Unions to sit-in on the meetings of the advisory committee and be involved in the development of policy discussions.

Finally, there is the special position which arises relative to role of the Inspectorate in the rehabilitation of the mine and its clearance for normal working. On this matter, the general approach which has been adopted in the United Kingdom is that this should be by agreement between management and representatives of the Unions but where difficulties or disagreement arises, then the Inspectorate would be involved. Indeed, this again is spelt out in mining safety legislation but it is very seldom invoked because of the levels of consultation which have preceded this final step. In actual practice, a joint inspection of the mine by management and workers representatives would have been preceded itself by an inspection by HM Inspectors who would make their views known jointly to both management and the Unions.

7 Investigation of Serious Mining Accidents

Any reference to the involvement of the Inspectorate in mine crisis management in the United Kingdom would be incomplete without some comment on the investigation and reporting procedures which must inevitably follow a major mining accident. In this respect, the successful investigation of virtually any accident, whether mining or otherwise, rests on the ability to marshall all factual evidence into a logical progression which provides a full picture of the circumstances of the accident. When this is achieved, then the conclusions are usually self evident, especially to expert eyes. Skilled investigation, however, like any other aspect of mine emergency planning, requires careful management and control, otherwise essential evidence may be lost and the full picture never known.

The three principal aspects of marshalling this evidence are, first, a detailed inspection and precise record of all relevant information at and around the site of the accident, secondly, the collection of statements by witnesses detailing the events leading up to the accident, and finally, the forensic examination and testing of associated equipment, systems, etc. For this purpose HM Inspectorate in the United Kingdom is legally empowered to act on its own behalf but the clear preference is for an open style of investigation which commends itself to involving all interested parties at all stages of the investigation and also of keeping them fully informed as and when factual information becomes available. In such circumstances, the need for an Inspector's statutory powers of enforcement is seldom, if ever, required.

The dissimilarity of the circumstances of most mining accidents tends to preclude a dogmatic approach to any investigation but despite this, there are fairly precise guidelines which must be followed and special reference should be made to the following aspects of the investigation of serious mining accidents in the United Kingdom, namely:

(i) During rescue operations rescue teams are requested to keep a careful note of the location of casualties and of any equipment which they may have disturbed during rescue operations. In this context, the police are requested to make a careful examination of the clothing of any casualties

(ii) As soon as the accident area has been declared safe, to arrange for the preparation of a detailed plan of the area in the proximity of the accident which will show the nature and location of all relevant data

(iii) Make arrangements for the questioning of witnesses by a small team of Inspectors, with representatives of management and the Unions being present, during which statements will be prepared

(iv) Where the primary cause of the accident is not known, to determine the sequence of forensic investigations which allows a process of elimination without damage to evidence

(v) Where the primary cause of the accident is known, to organise a specialist team of investigators which will essentially produce the expert evidence on which the findings and recommendations will be based.

(vi) The preparation of the report, its submission to the initiating authority, its publication and finally, a discussion on the action following the conclusions and recommendations with all sides of industry.

Needless to say, this part of the Inspectorate's involvement in any serious mining incident is the part which makes heaviest demands on the Inspectorate's resources. The emergency as such can very often be lifted within a few days and the rest of the mine cleared for normal working but it is not unknown for the residual work to extend into several years. For example, following the shaft winding disaster at Markham Main Mine in the East Midlands Coalfield in 1973 [5] a specialist Committee was set up to enquire into and make recommendations regarding modern safety requirements for winding. The work of this Committee was not completed until 1979 with the publication of its final report but notwithstanding the complexity and duration of their deliberations, everyone conversant with the safety aspects of shaft winding practice has recognised the tremendous progress which has been achieved and that the effort expended has been more than justified. In such circumstances there are no simple short cuts to a full and satisfactory solution of the problems involved.

8 Acknowledgements

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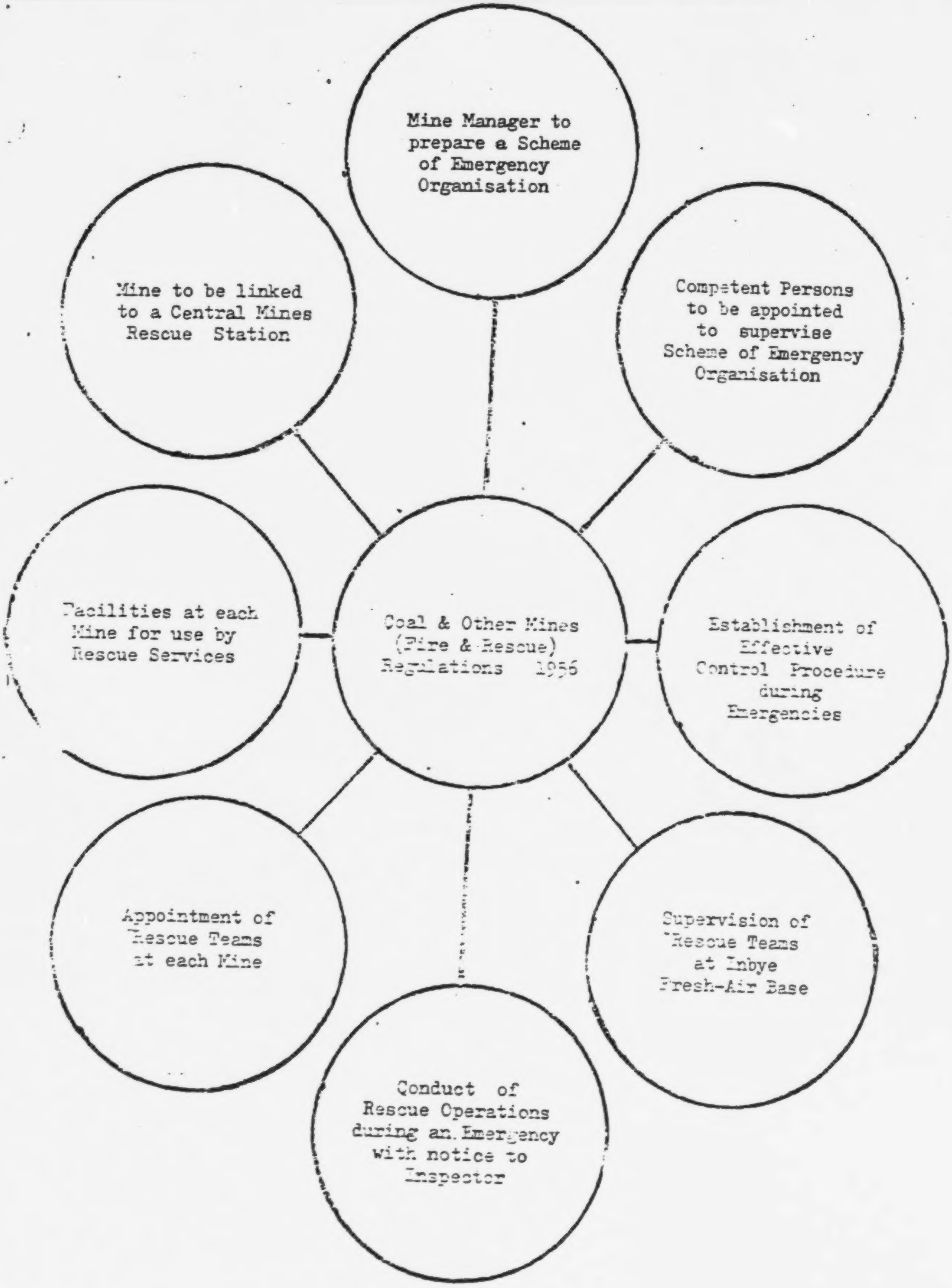

Mine Manager to prepare a Scheme of Emergency Organisation
Mine to be linked to a Central Mines Rescue Station
Competent Persons to be appointed to supervise Scheme of Emergency Organisation
Facilities at each Mine for use by Rescue Services
Coal & Other Mines (Fire & Rescue) Regulations 1956
Establishment of Effective Control Procedure during Emergencies
Appointment of Rescue Teams at each Mine
Supervision of Rescue Teams at Inbye Fresh-Air Base
Conduct of Rescue Operations during an Emergency with notice to Inspector

Fig. 1 - Statutory Requirements Relating to Mine Crisis Management

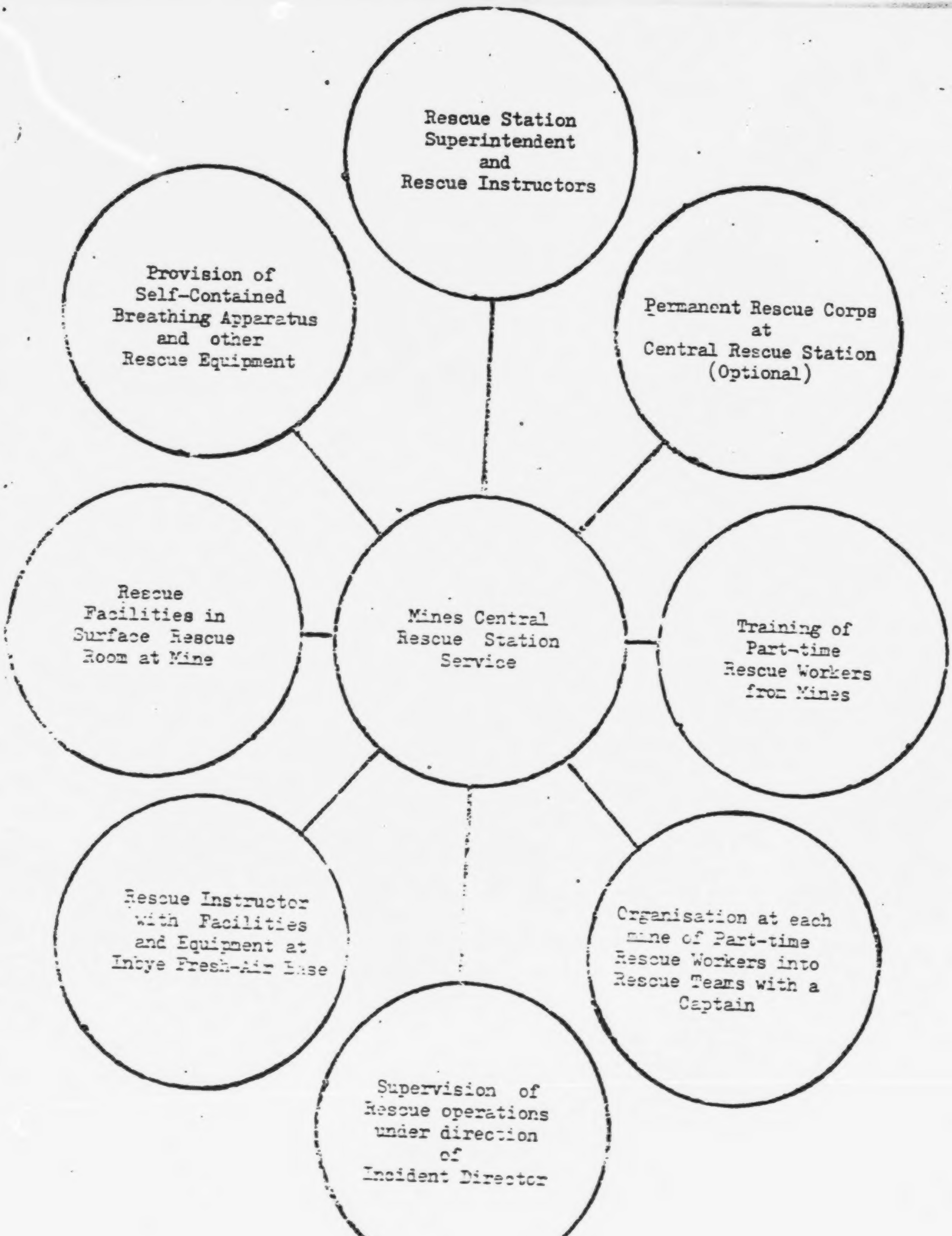

Rescue Station Superintendent and Rescue Instructors
Provision of Self-Contained Breathing Apparatus and other Rescue Equipment
Permanent Rescue Corps at Central Rescue Station (Optional)
Rescue Facilities in Surface Rescue Room at Mine
Mines Central Rescue Station Service
Training of Part-time Rescue Workers from Mines
Rescue Instructor with Facilities and Equipment at Inbye Fresh-Air Base
Organisation at each mine of Part-time Rescue Workers into Rescue Teams with a Captain
Supervision of Rescue operations under direction of Incident Director

Fig. 2 - Statutory Arrangements Relating to Central Mines Rescue Organisation

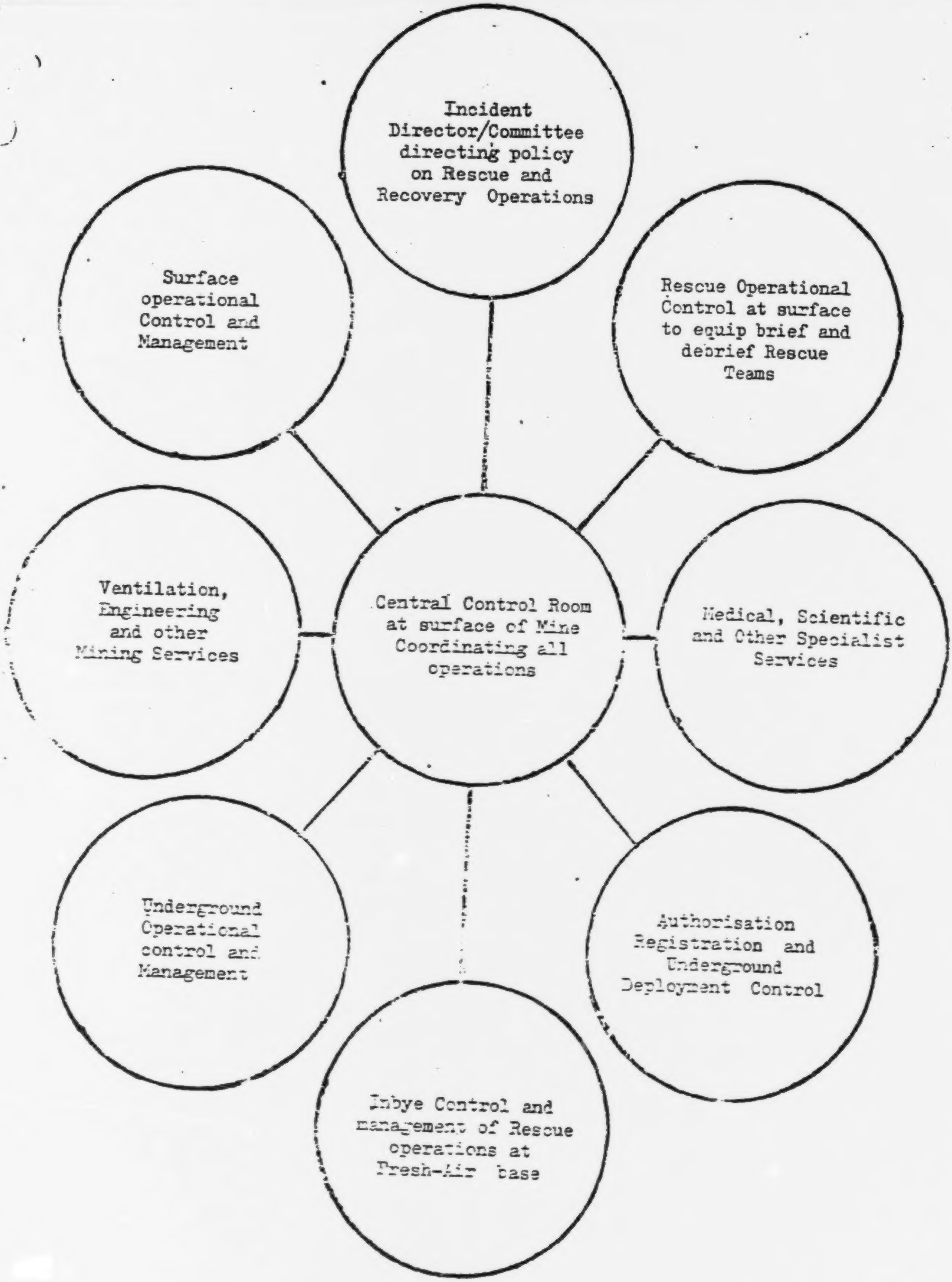
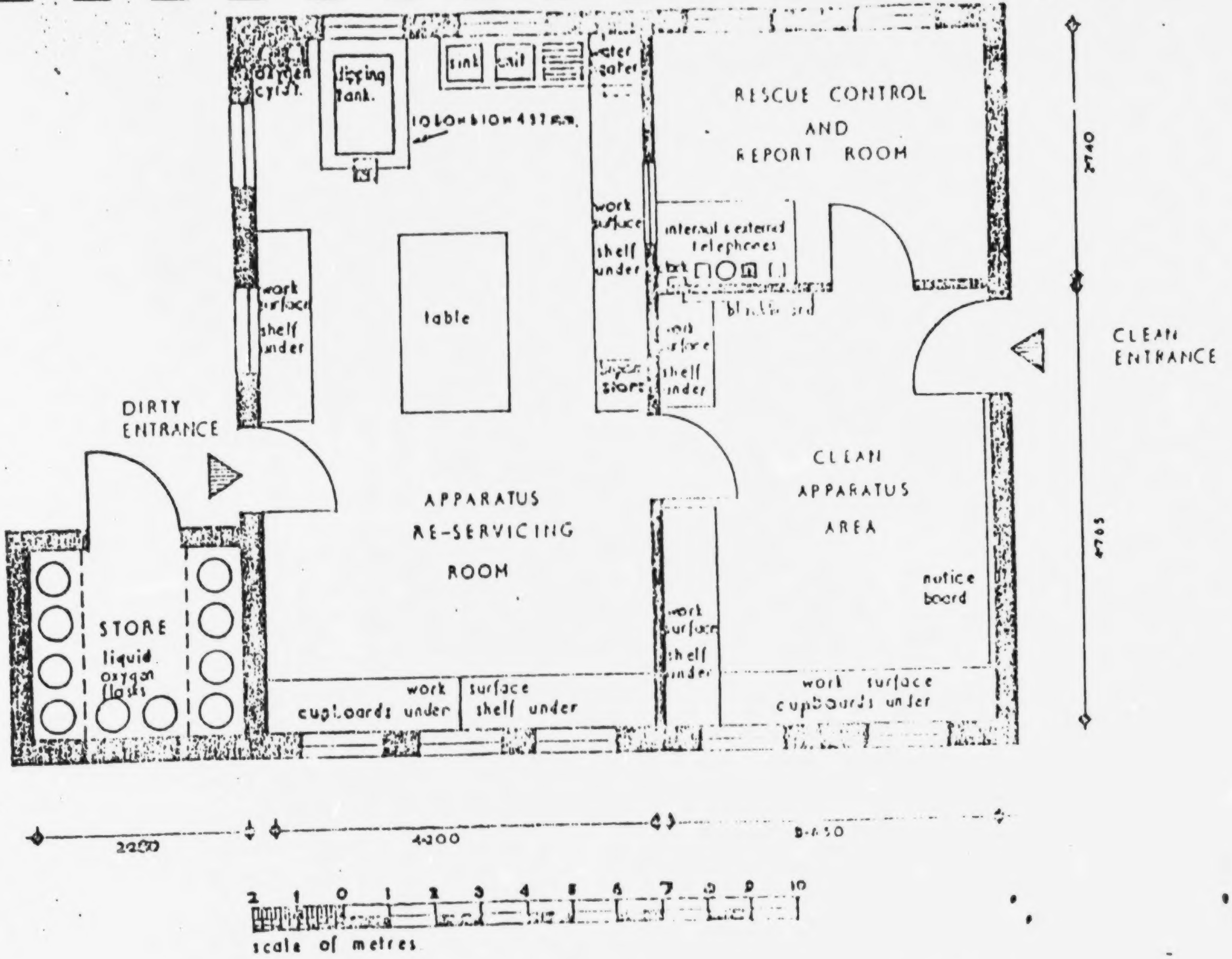

Incident Director/Committee directing policy on Rescue and Recovery Operations
Surface operational Control and Management
Rescue Operational Control at surface to equip brief and debrief Rescue Teams
Ventilation, Engineering and other Mining Services
Central Control Room at surface of Mine Coordinating all operations
Medical, Scientific and Other Specialist Services
Underground Operational control and Management
Authorisation Registration and Underground Deployment Control
Inbye Control and management of Rescue operations at Fresh-Air base

Fig. 3 - Control Arrangements During a Mining Emergency



oxygen cylsr.
dipping tank.
sink
sink
water heater
1010×610×457 mm.
RESCUE CONTROL AND REPORT ROOM
work surface shelf under
internal & external telephones
blackboard
work surface shelf under
store
work surface shelf under
table
DIRTY ENTRANCE
CLEAN ENTRANCE
CLEAN APPARATUS AREA
APPARATUS RE-SERVICING ROOM
notice board
STORE liquid oxygen flasks
work surface shelf under
work cupboards under
surface shelf under
work surface cupboards under
2740
4705
2200
4200
8·650
2 1 0 1 2 3 4 5 6 7 8 9 10
scale of metres

A TYPICAL COLLIERY RESCUE ROOM.

Fig. 1

APPENDIX IV
MINE RESCUE
OUTSIDE CANADA

SECTION 4.4

PART A GENERAL INFORMATION PROVIDED BY THE MINE RESCUE HEADQUARTERS, ESSEN, GERMANY.

(Translated From The German Language)

Enclosure Number	Title
No. 1	Federal Mining Law of August 1980 (references and extracts)
No. 2	Pit Coal Mining Regulations of Westfalia Mining Office
No. 3	Plan of Mine Rescue Organization
No. 4	Service Regulations for Mine Brigade Members
No. 5	Regulatory Procedures for Medical Examinations

Note on Translation of German Documents

A literal translation of the german documents was used.

In some cases the terminology used is not consistant with common English usage. For sake of uniformity, the literal translation was retained.

The readers should bear in mind that:

(1) Mine Brigade could be read as Mine Rescue Corps.

(2) Mine Rescue Post could be read as Mine Rescue Station.

(3) Brigade Sections could be read as Mine Rescue Team.

APPENDIX IV
MINE RESCUE
OUTSIDE CANADA

SECTION 4.4
REPUBLIC OF GERMANY

PART A GENERAL INFORMATION PROVIDED BY THE MINE RESCUE HEADQUARTERS, ESSEN, GERMANY.

PART B COPY OF FRANZ-JOSEF KOCK'S PAPER "USEFULNESS OF EXPERIENCE FROM EMERGENCY SITUATIONS AND EXERCISES, FOR THE WORK OF MINE RESCUE TEAMS".
(Presented at the International Symposium on Crisis Management, Sydney, N.S. October 1982).

Enclosure No. 1

FEDERAL MINING LAW OF AUGUST 13, 1980
(Federal Legal Publication I, Pg. 1310)

Headquarters for the Mine Rescue Organization

1. Contractors who operate an underground mining operation or a mining operation having installations with potential fire and explosion hazard will, where non breatheable or toxic gasses or fumes can occur, form and maintain or be associated with a headquarters for the mine rescue organization. This is an observance of mutual duties in the field of mine rescue and anti-gas protection operations.

2. The Federal Minister for Commerce has the power to issue regulations concerning the duties, number, organization, outfitting and equipment of the various headquarters, by legal order in council (with parliamentary consent), in so far as these regulations are necessary to preserve the obligations for safety and to guarantee that the different headquarters or their equivalent are at all times ready to respond to emergency situations.

3. Paragraph 58 to 62 are to be applied accordingly to all headquarters under mine rescue organizations, except for those which are maintained by state accident insurance companies. Paragraphs 69 to 74 are to be applied accordingly in order to insure compliance with paragraph one of this document, paragraphs 58 to 62, and with the legal orders in council referred to in paragraph 2.

Enclosure No. 2

PIT COAL MINING REGULATIONS OF THE NORTH RHINE WESTFALIA PROVINCIAL MINING OFFICE OF February 20, 1970

Section 6 - Mine Rescue and Anti Gas Protection Organization

Paragraph 65 - Mine Brigades and Anti Gas Protection Brigades

1. A mine brigade must be present at each active shaft installation and an anti gas protection brigade must be present at every coking plant.

2. The mine proprietors are obliged to supply the mining brigades and the anti gas protection brigades with anti gas equipment.

3. A room must be made available at the active shaft installation to the mine brigade and at the coking plant to the anti gas protection brigade where apparatuses and equipment can be stored and maintained (to be called the mine rescue station and the anti gas protection station).

4. Rooms for drills and training must be at disposal of the mine brigades and the anti gas protection brigades.

5. Breathing apparatus belonging to the mine brigade or the anti gas protection brigades may be used only by members of those brigades. The mining office can authorize some exceptions, but not in the case of closed circuit oxygen apparatuses.

6. A qualified maintenance technician must be assigned with maintenance of the breathing apparatus belonging to the mine brigade and the anti gas protection brigades for each brigade.

7. The training, formation, preparation, deployment and inspection of the various mine brigades and anti gas protection brigades must proceed according to plans approved by the provincial mining office.

Paragraph 66 - Members of the Mine Brigades and Anti Gas Protection Brigades

1. Only those persons who have been declared medically fit for service in the mine brigade and anti gas protection brigade may be members of the mine brigade and anti gas brigade, with the exception of equipment maintenance persons. Fitness for service must be controlled through medical examinations every two years.

2. All members of the mine brigades and the anti gas protection brigades must be given a copy of the service regulations.

Paragraph 67 - Commander of the Mine Brigade and Leader of the Anti Gas Protection Brigade

1. A person whose duties are to supervise the mine rescue organization and the leadership of the mine brigade shall be designated and installed as commander of the mine brigade.

2. A person whose duties are to superise the anti gas protection organization and the leadership of the anti gas protection brigade shall be designated and installed as the leader of the anti gas protection brigade.

Enclosure No. 3

PLAN OF THE MINE RESCUE ORGANIZATION

Table of Contents

1.0 Duties
2.0 Formation

2.1 Structure and Strength of the Mine Brigade
2.1.1 Structure
2.1.2 Projected Strength
2.1.3 Special Members
2.1.4 Guides

2.2 Acceptance in the Mine Brigade
2.3 Medical Examinations
2.4 Retirement from the Mine Brigade

3.0 Training

3.1 Basic Training
3.1.1 Theoretical Training
3.1.2 Practical Training
3.1.3 Completion of Basic Training

3.2 Inservice Training
3.2.1 Inservice Training of Leaders and Regular Brigade Members
3.2.1.1 General Information
3.2.1.2 Drills
3.2.1.3 Instruction Sessions

3.2.2 Inservice Training of Equipment Training Persons

3.3 Training of Mine Brigade Leaders and Equipment Maintanence Persons

4.0 Duties of the Mine Brigade Members

4.1 Mine Brigade Members
4.2 Equipment Maintenance Persons
4.3 Section Leaders
4.4 Commanders
4.5 Vice Commanders

5.0 Equipment and Facilities Belonging to the Mine Brigade

5.1 Mine Brigade Breathing Aparatus
5.2 Other Equipment
5.3 Mine Rescue Station

6.0 Operational Deployment of the Mine Brigade

6.1 Sounding the Alarm
6.2 Assistance
6.3 Direction of Operations
6.4 Stand-by Post
6.5 Principles of Deployment
6.5.1 Use of Breathing Apparatuses
6.5.2 The Strength of the Brigade Sections
6.5.3 The Reserve Section
6.5.4 The Advance of the Mine Brigade Sections
6.5.5 Retreat of the Mine Brigade Sections
6.5.6 Duration of Deployment

6.6 Advancing Under Difficult Conditions
6.6.1 General Information
6.6.2 Humid Conditions
6.6.3 Co-operation of Doctors on Extraordinarily Difficult Brigade Operations

6.7 Deployment of the Mine Brigade at High C_o levels

6.8 Deployment of the Mine Brigade During Inert Procedures (That is Oxygen Starvation)

6.9 __________ Maneuvers of the Mine Brigade

7.0 Records

8.0 The Rescue Operation

9.0 Notices Concerning the Plan of Operations

10.0 The Role of the Headquarters for the Mine Rescue Organization

1.0 DUTIES

The mine brigade is deployed underground to save and rescue people and to preserve property after explosions or in the event of fires in the mine or in any case where there is a possible danger from toxic gases or oxygen defficiency.

2.0 FORMATION

2.1 Structure and Strength of the Mine Brigade:

2.1.1 Structure:

The mine brigade is composed of:

The Commander (permanent employee)
The Vice Commanders (if possible, permanent employees)
The Section Leaders
The Regular Members of the Brigade
The Chief Equipment Maintanence Supervisor (if possible, a mining specialist)
The Equipment Maintenance Persons

The Commander, Vice Commanders and Section Leaders are responsible persons (paragraph 58, paragraph 1, no. 2 of the Federal Mining Law). The occupational groups employed in the mine, who are needed in the deployment of the mine brigade, are represented in the mine brigade. There are also special members of the mine brigade.

2.1.1 Projected Strength:

The number of the mine brigade sections (projected strength) is determined in agreement with the headquarters with the Mine Rescue Organization. The number reflects the particular circumstances of each mine, for example, the output of the mine, the number of the personnel, the layout of the mine installation and the location of the mine rescue station in relation to the cable transport shafts.

The strength of the central mine brigade, the number of sections which are kept there ready at all times are also taken into consideration.

Generally the projected strength of an active mine amounts to ten sections. A mine brigade section consists of a section leader and four men*1.

The actual strength of the mine brigade exceeds the projected strength so that the latter is maintained in the event of casualties. Special members are not included in the projected strength.

The shift scheduling for the personnel is arranged in such a way that, if possible, no more than two thirds of the mine brigade members are working underground.*2

2.1.3 Special Members:

Persons with special training and experience (for example, surveying inspectors, fire damp inspectors, staff engineers) as well as persons who have carried out leadership duties in the mine brigade, can belong to the mine brigade as special members. This is to make possible the completion of special tasks in situations where the mine brigade has to be deployed with breathing apparatuses. The following conditions are valid for special members:

- They are fit without limitation for service in the mine brigade;
- They have been active in the mine brigade at least five years, either as a brigade member or a leader;

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*1 In mining operations, other than underground coal mining, a mine brigade section consists of a team leader and three men.

*2 This is valid only for mines other than underground coal mines.

- They are at least forty years old;
- They have taken part in a section leader course at the headquarters for the mine rescue organization;
- Four times a year they must take part in two hour long drills using oxygen apparatuses. Two of these drills should be standard drills in the drill area;
- They are listed as special members in the special membership index (membership book);

2.1.4 Guides: (Only in Mines Other Than Pit Coal Mining):

Guides are to be trained just like candidates for the mine brigade. Twice a year they must take part in two hour long drills using oxygen apparatuses.

2.2 Acceptance in the Mine Brigade:

Enrollment in the mine brigade is voluntary. Applications are to be directed to the commander. Only those persons who fulfill the following qualifications are accepted in the mine brigade. They must:

- Be at least 18, and at the most 40 years old;
- Have worked underground for a period of at least one year immediately prior to acceptance in the brigade;
- Have been declared medically fit for service in the brigade;
- Have sucessfully completed training;

Only those persons who fulfill the following qualifications are accepted as equipment maintenance persons in the brigade. They must:

- Be fit for an occupation underground;
- Have a medical certificate stating that they do not have respiratory tuberculosis or any contagious skin disease which would make them unsuitable for a position involving maintenance of breathing apparatuses;
- Have successfully completed a basic course in equipment maintenance in at the headquarters for the Mine Rescue Organization following training by the chief equipment maintenance supervisor;

After successful completion of the basic training, candidates are listed in the membership index (membership book) and are thereby accepted into the mine brigade.

The date of admission into the brigade is the day of the first one hour long drill. Upon acceptance, members are given a copy of the service regulations for the mine brigade members. By signing the membership index (membership book), they confirm that they have received a copy. The signature also denotes acknowledgement of the duties set out in the service regulation.

After acceptance, the mine brigade members are issued with membership ID's in which the date of admission is certified.

2.3 Medical Examinations:

Applicants and members of the mine brigade - with the exception of maintenance persons who are not at the same time section leaders or regular brigade members - are examined for suitability for service in the mine brigade according to the "regulatory procedures for medical examinations".

The medical examinations establishing the fitness of each brigade member take place at intervals of at least every two years and sometimes more often if the doctor stipulates this. Members under twenty-two years of age and forty-one years of age and over are medically re-examined every year. Maintenance persons who are not at the same time section leaders or regular members of the brigade are exempt from this rule.

If a brigade member suffers from the effects of an illness or of an accident which could seriously impair his physical fitness, the commander must arrange another medical examination to determine if he is fit enough for mine brigade service. He may resume his dities with the mine brigade only after he has been declared medically fit.

2.4 Retirement and Resignation from the Mine Brigade:

Membership Ends:

- Through retirement from the brigade;
- If the Doctor certifies that the member is no longer fit for continued service in the brigade;

- For leaders and regular members of the brigade when they are fifty-one years of age and special members when they are fifty-six years of age;
- By forced resignation.

A member may be asked to resign if there is sufficient cause. This is especially the case if a member does not fulfill his obligations as part of the mine brigade in spite of a written reminder setting deadline in which to do so and indicating the possibility of expulsion from the brigade. Before being expelled, the member is given a chance to express his opinion on the matter. The member in question is informed of the expulsion by the commander.

3. TRAINING

3.1 Basic Training:

The basic training for applicants takes place over a period of no longer than one year and is divided into a theoretical and practical section.

3.1.1. Theoretical Training:

The following topics are dealt with in the theoretical training:

- Human Respiration;
- The Composition of Fire Damps, Flammable and Explosive Gases;
- The Effect of Toxic Gases - especially of carbon monoxide - and the consequences of oxygen deficit;
- The Assembly and Method of Operation of Oxygen Apparatuses, Instruction for Use of the Apparatuses;
- Emergency Procedures;
- Assembly and Method of Operation of Oxygen Generating Self Rescuers, Instructions for Use of the Apparatuses;
- Service Regulations for Mine Brigade Members.

At least four 1-hour long training sessions are included in the training.

3.1.2 Practical Training:

In the practical training the applicants are familiarized with working while wearing an oxygen apparatus. At least two 1-hour long sessions are spent on this training.

3.1.3 Completion of Basic Training:

To complete their training, the applicants take part in a two hour long drill in the drill area.

The applicants are admitted into the mine brigade when they have demonstrated the required knowledge to the commander and have successfully completed two hour long drills without interruption and objection.

3.2. Inservice Training:

3.2.1 Inservice Training of Leaders and Regular Brigade Members

3.2.1.1 General Information:

The practical inservice training of mine brigade leaders and regular brigade members takes place during training shift (and/ or in at least two hourly drills outside of work time). As much as possible the drills are spread out evenly over the year.

Leaders and regular brigade members take part in at least five training drills a year using oxygen apparatuses:

- One underground drill of at least four hours duration during a training shift.
- One drill lasting 90 minutes in flame proof clothing in a drill area.
- Three drills, each lasting at least two hours. At least one of these is a standard drill in the drill area.

Theoretical inservice training sessions also take place. These are carried out during training shifts or in the form of at least four additional instruction periods, each lasting two hours.

In addition each mine brigade member is trained how to help in an emergency and instructed in how to extinguish fires.

3.2.1.2 Drills:

The mine brigade has a drill area at its disposal where special drills can be carried out at elevated temperatures and in smoky conditions.

The drill area is equipped with a sufficient number of ergometric measuring instruments, for example, punching bags, ergometric bicycles and treadmills.

The drill area is equipped with an alarm system as well as with telephone hookups (mine brigade telephone II) which connects them with the drill supervisor. The drill area has emergency exits and cant be aired quickly.

The drills take place under the supervision of the commander or a section leader authorized by the commander. The supervisor does not take part in the drill himself.

During the compulsory underground drills for leaders and regular brigade members, tasks related to mine rescue are carried out, for example rescue of injured persons, first aid and resuscitation procedures, the erection of bulkheads and a temporary baricades, the setting up of communications, taking samples of flamable gases, descending blind shafts and so on.

The drills are not carried out in areas or mine shafts where there are toxic gases or an oxygen deficit.

The following drills are conducted in the drill area using oxygen apparatus:

- Standard Drill Lasting Two Hours

Standard drills are carried out at a dry temperature of 30°C; at the same time, the humid temperature should not exceed 28°C.

The clothing issued for the drill participants consisting of terry cloth underwear in accordance with DIN 23320 and the pants from flame proof suit.

During the drill, each participant must demonstrate his skill on the punching bag - at three times 60 punches - and his endeavor in this test lasting at least 15 minutes.

The drill area is covered in such a way that each break lasts no longer than 3 minutes and that the total rest time during the drill time does not exceed 30 minutes. The breaks are spent doing measuring tasks and training exercises. During the drills the participants also familiarize themselves with the mine brigade communications devices and practice the transition from oxygen apparatus to oxygen generating self rescurers.

- Drill Using Flame-Proof Clothing Lasting 90 Minutes

Drills using flame-proof clothing are carried out at a dry temperature of 30°C; at the same, the humid temperature should not exceed 28°C.

The issued clothing for the drill participants consists of complete flame-proof clothing in accordance DIN 23320.

During the drill each participant must demonstrate his strength on the pushing bag - 3 times 60 punches - and must run more than 20 metres on the treadmill.

A distance of 450 to 500 metres is covered in the drill area. Each break may last no longer than 5 minutes. During the breaks, all kinds of measurements are carried out. In addition, the participants practice using the mine brigade communication devices.

- Special Drills

Drills of other kinds are carried out to practice important skills - example procedure under difficult conditions simulated.

During the two hour long drills in the drill area, other tasks related to mine rescue are carried out according to training needs and instructions - for example drilling and erection of partitions.

3.2.1.3 Instruction Session:

The following topics are dealth with in instruction sessions:

- the design of the mine rescue organization,
- service regulations for mine brigade members,
- general information about breathing apparatus,
- assembly and method of operation of breathing apparatus on hand,
- toxic gases and oxygen deficiency
- conduct when a fire in the mine has been discovered and giving the alarm,
- standby post,
- procedure in emergency, especially in difficult conditions,
- operational deployment of the mine brigade in inert conditions,

- mine brigade measuring and safety devices and their use,
- taking gas samples,
- resuscitations,
- the origin, the prevention and fighting of fires in the mines,
- the construction of dykes and temporary partitions.

3.2.2 In Service Training of Equipment Maintenance Persons

The equipment maintenance persons are trained by the chief equipment maintenance supervisor at regular intervals.

At least every two months, they are given opportunity to familiarize themselves with all jobs which may have to be done on apparatus and equipment belonging to the mine brigade.

3.3 Training of Mine Brigade Leaders and Equipment Maintenance Persons

Mine brigade leaders and equipment maintenance persons are trained at the headquarters at the mine rescue organization and receive in service training at intervals of at the most 4 years.

Persons to be employed as maintenace persons are instructed by the chief maintenace supervisor in the inspection and maintenance of mine brigade equipment prior to their participation in the basic training course.

In addition to this, meetings are convened regularly at the headquarters of mine company offices to facilitate the interchange of ideas and experience. For example - commander conferences as well as commander consultations and chief maintenance supervisor consultations.

4.0 DUTIES OF THE MINE BRIGADE MEMBERS

4.1 Mine Brigade Members

Mine brigade members who have heard the alarm or who have heard of the alarm through other channels, must proceed immediately to the mine rescue post (or the position indicated in the alarm) and await further instructions.

During training and in emergency situations, members of the mine brigade are to obey the instructions of the commander or of a mine brigade leader authorized by the commander.

They are to take part in scheduled drills and instruction sections.

Mine brigade members are obliged to report to the person responsible for drills and regular brigade duty if they do not feel completely physically fit for service.

4.2 Equipment Maintenace Persons

Equipment maintenace persons inspect and maintain mine brigade breathing apparatus and equipment according to the regulations set down by the headquarters for the mine rescue organization. After each use, they make sure that a sufficient number of oxygen apparatus are made ready for use and that those oxygen apparatus that are not ready for use are marked as "not ready for use".

The chief equipment maintenace supervisor is additionally responsible for keeping the mine brigade equipment at the mine rescue post ready for use. If the supplies of servicable apparatus, spare parts and accessories, as well as other materials, are not positioned, the chief equipment maintenace supervisor is to report this to the commander.

The chief equipment maintenance supervisor sees to it that the apparatus are rotated so that each is used frequently during the drills using oxygen apparatus.

The chief equipment maintenance supervisor carries out the regular training of the other equipment maintenance persons. During at least three shifts he instructs candidates for the position of equipment maintenance person in the maintenance and inspection of mine brigade equipment before they take part in the basic training course at the headquarters for the mine rescue organization.

The equipment maintenance persons assist the chief equipment maintenance supervisor in the completion of his duties and substitute for him upon the orders of the commander.

4.3 Section Leaders

Section leaders carry out the instructions that they receive from the commander. During drills and in emergency situtations, they are section chiefs. They are not permitted to go beyond the orders given to them.

Section leaders report to the supervisor at the standby post after each active duty.

Special observations made during drills or after duty (for example shortage of apparatus, discontinuance of the drill or operation) are noted in the service book or operational log book.

4.4 Commanders

The commander is in charge of all members of his brigade during training and in emergency situations.

4.4.1 The Commander is Responsible That

1. The mine brigade is employed according to the order of the direction of operations,
2. Only those members of the brigade who have been certified medically fit for service take part in drills or active duty.

3. Drills and instruction sessions are held regularly and are supervised according to regulations (Section 3.2.1 and Section 3.2.2),
4. Special observations made during drills or active duty (for example shortage of apparatus, discontinuance of the drill or operation) are noted in the service book or operational log book, 5. Apparatus failure is reported immediately to headquarters for the mine rescue organization,
6. Accidents, which could have been caused with useage of breathing apparatus, are reported immediately by telephone to the mining office and to the headquarters for the mine rescue organization,
7. Applicants for acceptance in the brigade who fulfilled the qualifications according to Section 2.2 are trained. When he is sure that the candidate is sufficiently knowledgable concerning breathing apparatus, he is to supply them with a copy of the service regulations and their membership I.D.s upon acceptance into the brigade,
8. The membership index (membership book and drill book) as well as the service book and examination book are kept up to date,
9. The membership list of the mine brigade is kept up to date.

4.4.2 In Addition He Must Make Sure That

1. Arrangements have been made for his substitution,
2. The brigade has the necessary equipment at its disposal,
3. The ranks of the brigade are complete and ready for duty and that all the members can be notified quickly to report for duty in an emergency.
4. Planned operations of the mine brigade are reported in advance to the mining office and to the headquarters for the mine rescue organizations and that both are notified as soon as the brigade is deployed,
5. A copy "Plan of a Rescue Operations" is available at the mine rescue post,
6. Up to date plans of the ventilation system, the fire extinguishing system and the pipeline (water, air, and gas sections) are on the wall at the mine rescue post,

7. the membership list is available at each place mentioned in Section 7,
8. the required training and in-service training sessions for commanders, vice commanders, section leaders and equipment maintenance persons are held at the appropriate intervals mentioned in Section 3.3,
9. The headquarters for the mine rescue organization is informed of time and date of drills and instruction sessions. Also the headquarters is to be instructed by telephone of any sudden change of plans,
10. The up to date master plan of operations is to be filled out and along with any subsequent revisions or supplements submitted to the mining office and a copy of this information is submitted to the headquarters for the mine rescue organization,
11. The yearly report is submitted to the headquarters for the mine rescue organization every year by the first of February and a copy (minus the membership list) is submitted to the mining office,
12. The following is submitted to the mining office and to the headquarters for the mine rescue organization:
    - Report I: after each operation of the mine brigade using the breathing apparatus,
    - Report II: after any accident using breating apparatus,
    - Report III: after any resuscitation attempts carried out by the mine brigade.

The duties and responsibile persons are not affected by the above.

4.5 Vice Commanders

The vice commanders assist the commander in completion of his duties and substitute for him.

5.0 EQUIPMENT AND FACILITIES BELONGING TO THE MINE BRIGADE

5.1 Mine Brigade Breating Apparatus

Only approved breathing apparatus may be used in drills and operations.

5.2 Other Equipment

Instruments and apparatus used for measurement, inspection and resuscitation are kept ready for use at the mine rescue post. In addition, flame-proof suits with accessory underclothing and headgear and protective gloves in accordance with DIN 23320, for use when there is danger of explosion are kept in readiness.

Mine Rescue Post

Equipment belonging to the mine brigade is put in special rooms which are designated solely for use by the mine brigade. The equipment must be at least up to the standard of the basic equipment recommended the headquarters for the mine rescue organization. The equipment kept in central standby storage rooms is also taken into consideration here.

The commander and the chief equipment maintenance supervisor each have a key to the mine rescue post.

The mine rescue post has its own telephone connection (outside line).

6.0 DEPLOYMENT OF THE MINE BRIGADE

6.1 Sounding the Alarm

Members of the mine brigade must be able to be contacted immediately in case of emergency. In addition, those members of the mine brigade who are working below surface, must be able to be informed through the communication system available in the mine within a short time.

The short wave alarm system is inspected once a month ("apparatus test").

The mine brigade carries out an emergency alarm drill once a year (alarm drill). Written records are kept of the results of the drill. The time for the alarm drill is measured from the moment when the alarm is sounded to the moment when it is reported that two mine brigade sections with inspected apparatus and equipped with their first deployment as well as a commander or section leader are standing by at the mine rescue post (or the position indicated in the alarm).

The mining office is to be informed of any further alarm drill which are called in particular to test cooperation with persons or places outside the brigade or in the event of a mining disaster.

6.2 Assistance

The mine brigade comes to the assistance of neighbouring mines in the event of a mining disaster according to the plan for assistance. In each case, the properly equipped section are accompanied to the scene of the disaster by a commander and an equipment maintenance person. The commander reports to the mine rescue post or the position indicated in the alarm.

In the event that several brigades are employed in one mine, the duties and responsibilities of the commanders are defined and determined by the direction of operation.

Guides familiar with the location are to be supplied in the event that brigades from neighbouring mines are called upon for assistance. Brigades having answered the call for assistance, are briefed about what has actually happened and their duties before decent into the mine. Replacement teams and apparatus are made ready at the proper time.

6.3 Direction of Operations

In the event that the mine brigade is needed to save and rescue people, the mine manager or his representatives direct the procedures involved in saving injured or trapped persons.

Deployment of the mine brigade is always directed without exception above ground (direction of operations).

The makeup of the direction of operations (the role of the headquarters for the mine rescue organization, et al) is set out the "plan of rescue operations".

The director of operations gives the commander the information about each particular situation and the instructions necessary for the employment of the brigade. The commander in charge at the standby post is responsible for the detailed carrying out of the instructions. He reports to the director of operations at arranged time intervals. Unusual observations and events are reported immediately.

In the event that the commander below surface has to take emergency measures to ward off immediate danger, the director of operations must be notified immediately.

6.4 Standby Post

During the first deployment of the mine brigade, the reserve section remains at a "temporary standby post" where there is a telephone communication link with the director of operations.

As soon as possible and after consultation with the director of operations, one or more standby posts must be set up at appropriate positions - where they are, if possible, two telephone hookups - connected to the telephone network in the mine. When setting up the post, the following is taken into consideration - on the one hand, that the standby post is as close as possible to the place of deployment, and on the other hand, it is at a safe distance from the place of deployment.

The breathing apparatus and the equipment needed for the operation are stored here and are immediately made ready for use again after each use. Resuscitation apparatus and first aid equipment are also kept here. The reserve sections remain in the area of the standby post.

Communications between the standby post and the place with the brigade is deployed is set up.

The commander in charge or a section leader authorized by him is responsible for supervising the activities at the standby post.

The standby post is constantly manned by at least one equipment maintenance person. An operational log book is to be kept.

6.5 Principals of Deployment

6.5.1 Use of Breathing Apparatus

Only those breathing apparatus which have been inspected no longer than 8 days prior to use are to be used.

If the apparatus are not carried to the standby post individually, i.e. worn by a brigade member, then a general inspection of the apparatus is carried out.

Only new alkaline cannisters and oxygen tanks with pressure exceeding 180 bar are to be used.

All those members of the brigade working underground are to carry filter self rescuers with them at all times. Filter self rescuers are kept at the standby post for brigade members carrying breathing apparatus (oxygen apparatus, carbon monoxide filter apparatus, hose apparatus) belonging to the brigade or oxygen generating self rescurers.

Only brigade members may use the oxygen apparatus. The permission of the mining office is needed in the event that persons not belonging to the brigade are equipped with other breathing apparatus. Any jobs carried out by those persons are supervised by a brigade section leader.

During operations, the section leaders check the oxygen supplies of each oxygen apparatus at intervals of no more than 15 minutes.

6.5.2 The Strength of the Brigade Sections

The brigade advances only in units or sections made up of a section leader and four regular members.* Special members, mine supervisors and representatives of the headquarters for the mine rescue operation are not considered as part of the force. If the conditions are such that the deployment of small brigade sections is justifiable, then the commander may order this if he has the consent of the director of operations. A section leader, however, always accompanies advancing regular brigade members.

Individual brigade members may be given special jobs to do if they are under constant supervision.

6.5.3 The Reserve Section

The commander may deploy the brigade only if there is at least one reserve section standing by; generally, there is one reserve section for each section deployed.

In order to save people, however, the commander can - contrary to the above - send in the brigade even if there is no reserve section, but only if the necessary reserve sections are expected to arrive soon.

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* In mining operations other than pit coal mining, a section is made up of a section leader and three men.

6.5.4 The Advance of the Mine Brigade Sections

The commander in charge or the section leader authorized by him gives the necessary instructions for the operation to the section leaders. The sections advance using only inspected breathing apparatus.

Each section takes at least one oxygen generating self rescuer with it on operations.

During the advance, the measurements necessary for safety are carried out.

In each section, a second man, besides the section leader wears a breathing mask. If he is carrying a continuous radio communication kit, then he is to wear a radio communication mask.

6.5.5 Retreat of the Mine Brigade Section

Section leaders can start a retreat on their own initive regardless of their original instructions. The secion leader can order the section to retreat if:

- radio communications fail between the sections and the standby post,
- there is a casualty or a section member feels unwell,
- an oxygen apparatus malfunctions,
- the section meets with unforeseen difficulty (the mine supports are bad, there has been warm water in the tunnels over a considerable section of the tunnels, there is a substantial deterioration of the climatic conditions and the visibility),
- a mixture of explosive gases are detected (though this does not justify retreat when persons are being saved),
- the apparatus with the lowest supply of oxygen contains only double the amount of oxygen necessary for the retreat.

At any time the section may receive orders to retreat either directly from the commander at the standby post or indirectly from the direction of operations. The section always returns as a unit.

6.5.6 Duration of Deployment

1. Mine brigade sections using oxygen apparatus are usually deployed for a period of two hours.
2. In special cases the period of deployment may exceed two hours with the consent of the director of operations. However, the duration of any action depends upon the oxygen supply of the members involved.
3. When the humidity is high, the period of deployment should be shortened in accordance with Section 6.6.2.
4. There is a rest period of at least two hours after each period of deployment.

6.6 Advancing Under Difficult Conditions

6.6.1 General Information

Difficult conditions are present:
- in mines where the humidity is high,
- when the visibility is poor,
- in the fumes from open mine fires,
- in mine installations which are difficult to descend.

In addition, exploratory operations fall under the catagory of difficult conditions.

The following rules are to be followed even when the actual purpose of the brigade operations is already known (for example, rescue, firefighting) - at least during the first operation deployment.

During an advance under difficult conditions, the following is to be observed:

1. There is a continuous radio communication link between the standby post and the advancing section. If there is a break in communications, the advancing section is to go back and the reserve section is to come to meet them. The reserve section carries its own radio communications set.

   Before any equipment is used to transport personnel, it must be insured that an escape or retreat route is open at all times. This is also applicable when mine brigade troops use shaft trap support installations or tressels to descend mine shafts where flammable methane is piped out.

2. Each reserve section is to remain with oxygen apparatus ready at the closest point possible to the center of operations. The section has its own radio communication set.

3. The reserve section leader is to listen in on the communications between the standby post and the deployed section.

4. After the initial operation, the temporary communication system (mine brigade telephone I) is replaced by a more permanent communication set up (mine brigade telephone II).

   During stationary opreations, radio communications link is also set up between the standby post and the place of operations.

5. When visibility is poor, sections are to proceed by brigade ropes.

6.6.2 Humid Conditions

The following is to be observed when the mine brigade is deployed in a mine where the humidity is high:

1. Mine brigade members who are used to unfavourable climatic conditions and who are not yet 41 years of age, take presidence over other members.

2. Mine brigade members who have just recovered from an illness or who do not feel completely fit (for example influenza and related viruses, colds, the after affects of drinking alcholic beverages) are exempt. Special members are also excluded.

3. Mine brigade members wear light clothing - i.e. regulation flame-proof underwear, in accordance DIN 23320, which has been wet through. If there is danger of an explosion, however, flame-proof suits are to be worn.

4. The leader of the deployed section is to measure the humid temperature and the dry temperature with an appropriate measuring device (for example psychrometer) and report the results to the commander at the standby post. The humid temperature and the dry temperature should be measured at least at the beginning of the operation, after 5 minutes and then at intervals of 5 to 10 minutes.

Using the following table and the instruction given in points 5 and 6, the commander ascertains the admissible length of duration of the operations period.

humid temperature th [°C]	Length of Duration in Minutes		
	at t* less than 5°C	at t* 5 to 10°C	at t* greater than 10°C
29	90	85	80
30	80	75	70
31	70	65	60
32	60	55	50
33	50	45	40
34	45	40	35
35	40	35	30
36	35	30	25
37	30	25	20
38 - 40	25	20	15

* t = the difference between the dry temperature (t_d) and the humid temperature (th).

5. Ten minutes should be subtracted from the results for the length of duration obtained in the table for tasks involving greater physical extertion (for example climbing, descending mine shafts where there are hinderances, wearing flame-proof suits, walking in warm water in the tunnels).

6. At humid temperatures that exceed those given in the table, the length of duration must be decided in consulation with the direction of operation.

   During particularly strenuous operations in mine installations where there is only slight ventilation, the normal length of duration is shortened even when the humid temperature is less than those given in the table.

7. The mine brigade members are instructed before the start of operation that they are not to take any long breaks. Also they are to notify the section leader of any symptons of the onset of heat prostration (a heaviness in the legs, headaches, nausea, visual or hearing problems, etc.) The

commander is informed of the above over the mine brigade telephone. The section immediately begins a retreat and the reserve section is sent to meet them.

8. Blankets and hot beverages are provided for brigade members returning from active duty.

6.6.3 Cooperation of Doctors Under Extraordinary Difficult Brigade Operations

A doctor remains at the ready, possibly stationed at the standby post, to be able to assist immediately during extraordinarily difficult brigade operations (for example rescue operations lasting several days, descend of deep mines, blind shafts and low mine installations).

6.7 Deployment of the Mine Brigade at High CO Levels

Mine brigade members are deployed at CO levels of 100, 200 ppm. Their breathing apparatus are kept ready for use in direct vicinity of the place of operation. At these CO levels, brigade members work no longer than 90 minutes without a break. After each period of deployment there is a rest period of at least 2 hours duration in air free of CO.

A mine brigade member may work for a total of no more than 6 hours within 24 hour period. The CO level is repeatedly checked using either manual or CO measuring devices. Gas samples are taken as well at intervals of no more than 3 hours. These are analyzed as quickly as possible.

If other persons not belonging to the brigade also involved in the operations when the CO level is higher than 100 ppm, then all persons deployed in the operation are to wear CO filter apparatus or hose apparatus. Those persons not belonging to the brigade are to be supervised by section leaders.

Breathing apparatus must be used in mines where the CO exceeds 200 ppm.

6.8 Deployment of the Mine Brigade During Inert Measures that is Oxygen Deficit

Deployment of the mine brigade during inert measures is carried out according to Section 6.5 and Section 6.6.

All members of advancing sections are to be informed that they are in an inert unbreathable atmosphere. Those using mouthpieces are once again reminded not to speak.

Radio communications are to be set up with the standby post if sections are in an inert area. During operations in an inert area, each mine brigade section is to carry at least two oxygen generating self rescurers.

Additional oxygen generating self rescuers are available at the standby post.

A self contained resuscitation apparatus and a stretcher are to be kept near the place of operation in an inert area.

6.9 Planned Manoeuvres of the Mine Brigade

In addition to the necessary mine brigade operations - involving rescue, firefighting and elimination of dangerous situations - which are planned at short notice, the mine brigade is required to take part in planned maneuvres. Planned maneuvres to retain and regain fire field are carried out according to the guidelines contained in this section "Opening Fire Fields" in "Guidelines for Fire Protection Underground".

The mine brigade is also used to open and descend sealed mine shafts in which there is a good possibility of the presence of toxic gases or of an oxygen deficit.

In each case, it must be decided whether the maneuvre could be dispensed with if there were a complete ventilation of the shaft or a special ventilation system could be installed.

The mining office and the headquarters for the mine rescue organization are to be informed in advance of planned maneuvres. In some cases, the headquarters for the mine rescue coordination are called upon for advise in the planning of these maneuvres.

Participants in the maneuvres are to be informed in advance about the nature and extent of the exercise as well as about special regulations to be observed. Persons who are indirectly involved and possibly also the persons in charge in adjacent areas in the mining operations are also to be informed at the proper time.

During planned maneuvres in mines where there is humid conditions, regulations set out in Section 6.6 are to be especially observed.

Planned maneuvres are not carried out where there are explosive mixtures of gases.

7.0 RECORDS

The article "Medical Certification" (regulatory procedures for medical examinations) is used for the examinations mentioned in Section 2.3.

The following records are to be kept in the forms provided by the headquarters for the mine rescue organization:

- Report I: Concerning the deployment of the mine brigade using breathing apparatus,
- Report II: concerning accidents using breathing apparatus,
- Report III: concerning resuscitation operation carried out by the brigade,
- Training course certificates,
- Service book,
- Inspection book for mine brigade equipment,
- Yearly report.

The following records are kept according to models provided by the headquarters for the mining rescue organization:

- the membership index (i.e. membership book and drill book)
- the membership list

A membership list must be kept:

1. in the mine rescue post,
2. in the office of the director of operations and at other places which may be necessary.

8.0 THE RESCUE OPERATION

The area of duties and responsibilities for persons involved in a rescue operation (Paragraph 61, Paragraph 1, Number 2 of the Federal Mining Law) are set out in the "plan for a rescue operation". The stipulations contained in the plan are to be applied accordingly during other operations of the mine brigade. The plant contains rules for the following:

1. sounding the alarm for all persons involved in the rescue operation,
2. the immediate procedures for the temporary director of operations,
3. the duties of the director of operations,
4. the duties of the otherwise involved persons, and so on.

In addition, the plan contains the series of forms which can be obtained from the appropriate places (for example, the office of the director of operations) as well as lists of material to be used in the operations which is stored at the shaft installations (for example in fire extinguishing cabinets) or in central standby depots and at the headquarters of the mine rescue organization. Enclosed in the plan are also regulations and plan which are related to the mine rescue operation.

According to the plan, mine brigade members - with the exception of special members - are to be entrusted only with tasks related to the mine rescue brigade.

The plan for a rescue operation is to be made available in the office of the director of operations in the mine rescue post and at other necessary places. It is to be revised every six months.

9.0 NOTICES CONCERNING THE PLAN OF OPERATIONS

The form concerning the main plan of operations (enclosure)*, are to be submitted to the mining office. The mining office is thereby notified that the circumstances of each mine brigade (projected strength and structure, training, the alarm system, standby service, equipment). The mining office is to be notified of any subsequent changes or supplements. The headquarters for the mine rescue organization is to receive a copy of the above notices.

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* supplements to the plan as well as changes approved by the provincial mining office for North Rhine Westfella

10.0 THE ROLE OF THE HEADQUARTERS FOR THE MINE RESCUE ORGANIZATION

10.1 The mine is to be connected to the headquarters for the mine rescue organization in accordance with paragraph 131 of the Federal Mining Law.

The following duties are assigned to headquarters for the mine rescue organization:

1. to provide advice, support, and cooperation during rescue operations and other brigade operations,
2. to provide advice concerning questions about brigade equipment and organization,
3. to maintain a standby storage depot,
4. to set up the plan of assistance for the mine brigade,
5. to help set up and adjust the protective strength of the brigade,
6. to inspect the mine brigade at the mine rescue post as well as their apparatus and equipment on a regular basis,
7. to carry out training courses for commanders, section leaders, and equipment maintenance persons,
8. to assist the commanders in the training of the mine brigade members,
9. to inspect the mine brigade breathing apparatus following accidents (Section 4.4.1.6).

The above "plan of the mine rescue organization - September 1982 edition" including the enclosure "master plan of operation" is in compliance with Paragraph 65, Paragraph 7 of the North Rhine Westfalia provincial mining office mining regulations of February 20, 1970 for pitcoal mining as well as with Paragraph 61, Paragraph 6 of the north rhine westfilla provincial mining office mining regulations of February 20, 1970 for ore and salt mining operations and for stone and earthworks.

Reference No. 12.61.1-3-18
Dortment, October 28, 1982
North Rhine Westfalia Provincial Mining Office
Signed: Coenders

Enclosure No. 4

HANDBOOK

TITLE:

SERVICE REGULATIONS FOR MINE BRIGADE MEMBERS

FOR MINE BRIGADE UNDER THE DIRECTION OF THE PROVINCIAL MINING
OFFICE FOR NORTH RHINE WESTFALIA

HEADQUARTERS FOR THE MINE RESCUE IN ESSEN, 1982

Table of Contents

1.0 Membership
2.0 Duties
2.1 Mine Brigade Members
2.2 Commanders
2.3 Section Leaders
2.4 Equipment Maintenance Persons
2.5 Special Members
3.0 Medical Examinations
4.0 Drills and Instruction Sessions
5.0 Use of Oxygen Apparatus
6.0 Accidents Using Breathing Apparatus
7.0 Operational Deployment
8.0 Additional Instruction for Equipment Maintenance Persons
8.1 Issuing Breathing Apparatus
8.2 Duties of the Equipment Maintenance Person at the Standby Post
8.3 Inspection of Breathing Apparatus
8.3.1 Inspection of Oxygen Apparatus
8.3.2 Inspection of Breathing Masks
8.3.3 Inspection of Oxygen Generating Self Rescuers
8.4 Inspection of Measuring Equipment and Other Auxilliary Equipment
8.5 Inspection of Membranes and Seals
8.6 Cleaning and Disinfection
9.0 Rules for Using Oxygen
9.1 General Information
9.2 Rooms
9.3 Filling Pump
9.3.1 Oxygen Dryers
9.3.2 Water Separators
9.3.3 Lubrication
9.4 Pipes
9.5 Danger of Fire
9.6 Oxygen Supply Tanks
9.7 Oxygen Apparatus Oxygen Tanks
9.8 Other Oxygen Tanks
9.9 Oxygen Distributors

1.0 MEMBERSHIP

A mine brigade member is someone who has been accepted into the mine brigade after having successfully completed basic training and having been entered in the membership index (Membership Book).

The date of admission into the brigade is the day of the first one hour long drill.

After acceptance, the mine brigade members are issued with membership I.D.s in which the date of admission is certified.

The membership I.D. is no longer valid after the member resigns or retires from the brigade.

Every mine brigade member receives a copy of these service regulations as well as a copy of "Design of the Mine Rescue Organization".

Receipt of a copy of the service regulations must be confirmed by the member's signature in the membership index (Membership Book). Their signature also denotes aknowledgement of the duties set out in the service regulations.

Regular brigade members and brigade leaders must retire from the brigade when they reach 51 years of age; special members must retire when they reach 56 years of age. Membership can also be terminated if examining doctor certifies that a member is no longer fit for continued service in the brigade.

Membership can also be terminated through retirement for forced resignation. A member may be asked to retire if there is sufficient cause. This especially the case if a member does not fulfill the obligations as part of the mine brigade in spite of a written reminder setting a deadline in which to do so and indicating the possibility of expulsion from the brigade. Before being expelled, the member is given a chance to express his opinion on the matter. The member in question is informed of the expulsion by the commander.

2.0 DUTIES

2.1 Mine Brigade Members

During training and in emergency situations, members of the mine brigade are to obey the instruction of the commander or of the mine brigade leader authorized by the commander. Mine brigade members who have heard the alarm who have heard of the alarm through other channels must proceed immediately to the mine rescue post (or to the position indicated in the alarm) and await further instructions.

They are to take part in scheduled drills and instruction sessions. Mine brigade members are obliged to report to the person responsible for drills and regular brigade duty if they do not feel completely physically fit for service. (See Section 3.0).

Mine brigade members are responsible for their own physical fitness so that they can withstand the rigors of duty.

2.2 Commanders

The commander is in charge of all members of his brigade (including special members) during training and in emergency situations). He is responsible that the regulations set out in "design of the mine rescue organization" are followed and carried out. The commander is responsible that the maximum heart beat frequency is not exceeded when endurance testing is carried out using the Ergometric bicycle. Furthermore, he is reponsible for that the apparatus are in good working order.

The vice commanders assist the commander in the completion of this duties and substitute for him.

2.3 Section Leaders

Section leaders must follow the instructions of the commander.

During drills and in emergency situations, section leaders are responsible for their section. They may not go beyond the orders given to them.

The section leader must immediately report to the supervisor any unusual occurrences during drills and active duty (for example apparatus failure, sudden illness of a section members, etc.) and record it in the service book or operational log book.

2.4 Equipment Maintenance Persons

Equipment maintenance persons are to inspect and maintain apparatus and equipment according to the regulations set down by the headquarters for the mine rescue organization. They make the apparatus immediately ready for use again after each time they are used. They are to mark defective apparatus as "not ready for use".

The regulations entitled "Additional Instructions for Equipment Maintenance Persons" found in Section 8 of this manual as well the "Rules for Working with Oxygen" in Section 9 also apply for equipment maintenance persons.

The chief equipment maintenance supervisor is also reponsible for keeping the mine brigade equipment at the mine rescue post ready for use.

If the supplies of servicable apparatus, spare parts and accessories as well as other materials are not sufficient, the chief equipment maintenance supervisor is to report this to the commander.

He is to see to it that the apparatus are rotated so that each is used equally as frequently during the drills.

The chief equipment maintenance supervisor is also to carry the regular training of the other equipment maintenance persons.

During at least 3 shifts, he is to instruct candidates for the position of equipment maintenance person in the maintenance and inspection of mine brigade equipment before they take part in a basic training course at the headquarters for the mine rescue organization.

The equipment maintenance persons are to assist the chief equipment maintenance supervisor in the completion of his duties and substitute for him upon the orders of the commander.

2.5 Special Members

During training and in emergency situations, special members are to obey the instructions of the commander or of a mine brigade leader authorized by the commander. During operations, they are to be available to carry out special tasks.

3.0 MEDICAL EXAMINATIONS

Every brigade member - with the exception of maintenance persons who are not, at the same time, regular brigade members - must be examined for suitability of service in the mine brigade.

The medical examinations, establishing the fitness of each brigade member, take place at intervals of at least every two years and sometimes more often if the examining doctor stipulates it. Members under 22 years of age and 41 years of age and over must be medically re-examined every year.

If a brigade member suffers from the effects of an illness or of an accident that could seriously impair his physical fitness, he must report this to the commander. The commander must arrange another medical examination to determine if he is fit for mine brigade service. The member may resume his duties with the mine brigade only after he has been declared medically fit.

Every equipment maintenance person must be medically examined to determine that he is free of respiratory tuberculosis and contagious skin diseases. The medical examination must be repeated at intervals of 2 years unless the doctor stipulates they be carried out more often.

If there is reason at any time to suscept that he might have contracted either contagious skin disease or respiratory tuberculosis, an equipment maintenance person must undergo a re-examination.

4.0 DRILLS AND INSTRUCTION SESSIONS

Every mine brigade member is obliged to take part in scheduled drills (for endurance testing and assessment). The drills should be spread out evenly over the year.

Leaders and brigade members must take part in at least 5 drills a year using oxygen apparatus:
- 1 underground drill of at least 4 hours duration during a training shift,
- 1 drill lasting 90 minutes in flame-proof clothing in the drill area,
- 3 drills each lasting at least 2 hours. At least 1 of these should be a standard drill in the drill area.

Special members must take part in four, 2 hour long drills per year; 2 of these must be standard drills in the drill area.

Guides (only in mining operations other than underground coal mining) must take part in 2 drills each lasting 2 hours.

Drills are considered to be completed only if they have been conducted without interuption or objection.

If instruction sessions are not conducted during training shifts, leaders and brigade members must attend 4 additional 2 hour long instruction sessions.

At certain intervals (at least once a year) mine brigade members must undergo a fitness assessment supervised by the commander or someone authorized by him. The testing is carried out on a ergometric bicycle with an automatic heartbeat recording device. The results are entered into a formula and recorded in tables for each individual for the purpose of comparison (for internal use).

Mine brigade members who fall below the standard on any of the fitness tests are required to improve their physical fitness and to give proof of their fitness before the next official brigade drill.

Every mine brigade member must be trained in how to help in an emergency and instructed in how to extinguish fires.

At least every 2 months equipment maintenance persons must familiarize themselves under the direction of the chief maintenace supervisor, with all jobs which may have to be done on apparatus and equipment belonging to the mine brigade. They must also take part in in-service training sessions.

5.0 USE OF OXYGEN APPARATUS

Procedures for use of oxygen apparatus:

1. Put on the Air Connection.
(a) Mouthpiece set: gas protection glasses, mouthpiece (do not put on the nose clamp, yet).
(b) Breathing mask: check for leaks with ball of thumb.
2. Don the apparatus.
3. Line up the sections.
4. Each man must open the tank valve of the man in front of him (equipment maintenance person or the section leader is to attend to the last man in the line).
5. The equipment maintenance person or the section leader is to connect the air hoses. In no case should the apparatus wearer do this himself. Check for leaks.
6. Put on the nose clamps.
7. The section is to push the manual button 2 or 3 times while at the same time watching the pressure gauge. The tank pressure should be at least 180 bar.
8. Record the oxygen supply level.

The section leader is responsible that the oxygen apparatus are put on and used in according to regulations.

6.0 ACCIDENTS USING BREATHING APPARATUS

In case of accidents which could have been caused in connection with the use of breathing apparatus, proceed as follows:

The section leader or his substitute is to shut off the oxygen tank of the apparatus in questions after recording the oxygen supply levels. Leave the air connection unchanged on the double accordian hose. The commander is then, in consultation with the mining office, to take the untouched apparatus at the disposal of the headquarters for the mine rescue organization.

7.0 OCCUPATIONAL DEPLOYMENT

Operations of the mine brigade are always directed, without exception, from above ground (director of operations).

The commander receives his instructions from the director of operations and regulates the details involved in the deployment of the brigade. At agreed time intervals he reports the progress of the operation to the director of operations. He reports unusual operations and occurrences immediately.

The mine brigade may use only inspected breathing apparatus. If these apparatus are not carried individually to the standby post (that is, worn by a brigade member) then a general inspection of the apparatus must be carried out before they are put on.

The mine brigade may advance only as a unit (in pitcoal mining: 1 leader and 4 men or in other types of mining: 1 leader and 3 men).

If the conditions are such that the deployment of smaller brigade sections is justifiable, then the commander may order this, if he has the consent of the director of operations. A section leader, however, must always accompany advancing regular brigade members. Individual brigade members may be given special jobs to do if they can be under constant supervision. If, in exceptional cases, a small section is deployed, then the reserve section must be at full strength.

Section members using mouthpiece and nose clamps are not permitted to speak. Sign language must be used for communication.

Any member of the brigade who experiences any difficulty while using the breating apparatus must report this immediately to the person responsible. This especially important if they notice any symptons of the onset of heat prostration (heaviness in the legs, headache, visual and hearing problems, nausea, etc.). During an operation, if a section member reports difficulties, then the section is to return immediately as a unit. A reserve section is immediately sent to meet them.

Mine brigade members who have just recovered from an illness or who do not feel completely fit (example influenza or related viruses, colds, the after affect of drinking alcohol, etc.) must report this to the commander.

If a continuous radio communications link (mine brigade telephone I) is carried with the section, then, a second man beside the section leader is to wear a special mask enabling radio communication. If the radio communications fail then the section is to return the unit and the reserve section is to come to meet them. The reserve section carries its own radio communication set.

8.0 ADDITIONAL INSTRUCTIONS FOR EQUIPMENT MAINTENANCE PERSONS

8.1 Issuing Breathing Apparatus

Oxygen safety apparatus may be issued only to mine brigade members. Other types of breathing apparatus may be issued to non-members of the brigade only on the specific instructions of the commander.

8.2 Duties of the Equipment Maintenance Person at the Standby Post

During operations, equipment maintenance persons are to be relieved of duty in such a way that standby post is always manned by at least 1 equipment maintenance person.

The equipment maintenance person at each standby post is responsible for the inspection and maintenance of the apparatus and equipment allotted to him and their accessories. If the apparatus are not transported individually to the standby post, then a general inspection of the apparatus must be carried out before they are used. Only new alkaline cannisters and oxygen tanks with the pressure of least 180 bar may be used in operations.

The mine brigade equipment at the standby post which is ready for use (apparatus spare parts and accessories) is to kept distinctly separated from the equipment which is not ready for use. The brigade equipment which is ready for use should be stored on that side of the standby post closest to the place of operation and the equipment is not ready for use should be stored on the side furthest away from the place of operation.

8.3 Inspection of Breathing Apparatus

The mine brigade may use only inspected apparatus.

The apparatus are considered to be inspected only if the last - weekly or monthly - inspection took place no more than 8 days previously and during that time no unauthorized person has access to the apparatus. Of course, in any case, the oxygen supply level of each individual oxygen apparatus must be checked before the descent for operations deployment.

If safe transport of the apparatus to the standby post must be gauranteed, then a general inspection must be carried out before use.

8.3.1 Inspection of Oxygen Apparatus

The following inspections of oxygen apparatus are to be conducted, using an appropriate inspection instrument, in compliance with the inspection guidelines laid down by the headquarters for the mine rescue organization for each type of apparatus.

(a) Before use.
(Disregard this if the stipulation sent down in Section 8.3 are fulfilled.)

Check for leaks for over pressure and low pressure (safety valve at warning signal).

Check tank pressure, check for leaks in high pressure and medium pressure parts as well as the pressure gauge.

(b) Weekly.
as under (a).

If everything is in order, mark the apparatus as "ready for use"; mark the date of inspection and initials on each apparatus.

(c) Monthly.
General inspection of the apparatus.

Record the inspection results in the inspection book. If everything is in order, mark the apparatus as "ready for use"; mark the date of inspection and initials on each apparatus.

(d) After Use and Assembly.
General inspection of the apparatus as under (c).

If everything is in order, mark the apparatus as "ready for use"; mark the date of the inspection and initials on each apparatus.

8.3.2 Inspection of Breathing Masks

Breathing masks are to be inspected using the mask air-tight inspection device. Inspections are to be conducted monthly, after extended or heavy use, as well as after repairs. When mouthpiece membranes are removed (at least once a year!) then the masks are to be inspected after re-assembly.

The electrical parts of radio communication masks are to be removed before cleaning the masks. The masks are to inspected after re-assembly.

The electrical parts are to be inspected monthly and after extended heavy use.

When inspecting the masks, note the operating instructions for each breathing mask.

8.3.3 Inspection of Oxygen Generating Self Rescuers

Inspection of oxygen generating self rescuers which are used as auxilliary apparatus by the brigade, are to be conducted in compliance with the inspection guidelines laid down by the headquarters for the mine rescue organization.

The following inspection should be carried out for the oxygen generating self rescuer Oxy-SR-45:

(a) Before Use.

Check the oxygen supply level and that the lead seal is undamaged.

(b) Monthly.

Check the oxygen supply level and for leaks for over pressure and low pressure. If everything is in order, mark the apparatus as "ready for use"; mark the date of inspection and initial each apparatus.

(c) Every Six Months.

General inspection of the apparatus.

A general inspection of the apparatus is also necessary after heavy use and after manufacture. If everything is in order, mark the apparatus as "ready for use" mark the date of inspection and initial each apparatus. The results of the monthly and half yearly inspection are to be recorded in the inspection book.

Oxygen generating self rescuers must be used at least once a year.

8.4 Inspection of Measuring Equipment and other Auxilliary Equipment

Measuring equipment and other auxilliary equipment kept ready for use by the mine brigade must be inspected monthly. The inspection results must be recorded in the inspection book. When inspecting measuring equipment, the appropriate guide lines set down by the North Rhine Westfilla Provincial Mining Office for the use as inspection of manual measuring instruments and portable measuring equipment must be observed.

8.5 Inspection of Membranes and Seals

Plastic or rubber membranes, seals, and valves are to be inspected at least once a year (for signs of aging, crumbling, and deformation, etc.). They must be replaced at least every six years insofar as the manufacturer does not stipulate a shorter period. Rubber and plastic oxygen distributors are exempt from this ruling.

8.6 Cleaning and Disinfection

Air connectors and accordian hoses are to be cleaned and disinfected after each use.

The air connectors do not have to be disinfected at the standby post for subsequent use by the same man.

Breathing bags and valve cases are to be cleaned and disinfected after extended or heavy use or when heavily soiled or at intervals of 6 months at the latest.

9.0 RULES FOR USING OXYGEN

9.1 General Information

Oxygen to be used for breathing purposes must be at least 99 percent pure. Oxygen may not be used in place of compressed air. It is not permitted clean apparatus or clothing with oxygen.

9.2 Rooms

All rooms in which oxygen is stored or where tanks are filled with oxygen must be adequately ventilated. The doors to these rooms must be fire resistant, open outwards and close automatically.

9.3 Filling Pump

In order to guarantee trouble free operation of the oxygen filling pump, it must be carefully cared for and maintained. This includes continuous cleaning as well as timely replacement of defective cuffs.

9.3.1 Oxygen Dryers

Oxygen dryers on oxygen filling pumps must undergo official internal inspection every 4 years and an official pressure test every 8 years.

An inspection book is attached to each oxygen dryer. The drying cartridge may not absorb more than 40 grams of moisture.

9.3.2 Water Separators

Water separators must undergo an official internal inspection every 4 years an official pressure test every 8 years.

An inspection book is attached to each water separator.

9.3.3 Lubrication

Only a mixture of glycerin and distilled water in the ratio of 1 to 4 may be used to lubricate oxygen filling pumps. If the remainder of the lubricant in the tub is not enough to lubricate a pump properly, then, on principle, the lubricant should be discarded and replaced by a fresh mixture. The lubricant tube should be thoroughly cleaned before hand. In special cases, if there is not sufficient time to refill the tube, then the available lubricant is to be supplemented with distilled water. In no case is the lubricant to be supplemented with waterless mixture.

9.4 Pipes

All pipes used for oxygen in the filling equipment must be made of copper.

9.5 Danger of Fire

Smoking and open fires are prohibited in the filling rooms. There must be sign stating this in the room. Oxygen may not be stored together with easily flammable, explosives or spontaneous combustible materials.

Parts which come in contact with oxygen must be free of oil and grease; also avoid bring oil lubed cleaned clothes or greasy fingers in contact with oxygen. When using oxygen do not wear clothes smeared with oil or grease. It is especially important to note while filling tanks with oxygen that no substantial enrichment of the air with oxygen takes place.

9.6 Oxygen Supply Tanks

Oxygen supply tanks must undergo an official inspection every 10 years.

The dates of inspection are to be listed.

When storing oxygen supply tanks, secure them against accidents and keep them away from any heat source.

9.7 Oxygen Tanks

These oxygen tanks with a two litre capacity used in mining operations are to be officially inspected every three years. This is divergent from the compressed gas regulations. The dates of inspection are to be listed.

When the date of inspection has been passed, the oxygen tanks in questions must be emptied.

The valves on empty oxygen tanks must be kept closed.

Completely emptied and inspected oxygen tanks are to be washed out before filling with oxygen.

Oxygen tanks may be transported only when the safety cap is screwed on.

Oxygen tanks valves must be easily accessible.

When storing oxygen tanks, lay them down separately and turn from time to time.

9.8 Other Oxygen Tanks

Oxygen tanks for oxygen generating self rescuers are to undergo an official pressure check every six years. The dates of inspection are to be recorded.

9.9 Oxygen Distributors

All the oxygen distributors (including the main valve on the Oxy-SR-45) are to be sent back to the manufacturing factories for complete overhaul at least every six years. The dates of overhaul are to be listed.

Enclosure No. 5

REGULATORY PROCEDURES FOR MEDICAL EXAMINATIONS; EXAMINATIONS OF MEMBERS OF MINE BRIGADES AND OF THE ANTI-GAS PROTECTION BRIGADES

The regulatory procedures for medical examinations are presently being revised. At the suggestion of the special committee "Mine Rescue Organization" of the Pitcoal Mining Association, the committee "Labour Protection and Labour Medicine" recommends that the part of the regulation dealing with the examinations of members of the mine and anti-gas protection brigades can already be applied.

We have enclosed the corresponding part of the regulations.

The German National Sport Institute in Cologne have carried out research on the data acquired in the endurance testing of mine brigade members.

Some of the results of this research are enclosed suggestions for endurance testing and for the improvement of mine brigade member's endurance.

Signed, Cherio
Joint Union of German Pitcoal Mining Operations
Signed by: Rosener and Gierhardt

EXCERPT FROM REGULATORY PROCEDURES FROM MEDICAL EXAMINATION IN PIT COAL MINING OPERATIONS

as of January 1982

D2 Mine Brigade (with the exception of equipment maintenance person)

Members of the mine brigade must be able to withstand great physcial exertion at high temperature and high humidity. They must be able to cope with a high level of pysological stress.

Not only the physical constitution of the member plays an important role here but also his physical fitness.

Persons whose body weight exceeds their ideal weight by more than 50 % are generally not suitable. The examining doctor may disregard this rule if he deems it justifiable on the basis of the other test results.

The ideal weight is calculated using the Brocka formula (Height in cm minus 100).

It should be marked on the medical certificate for persons of removal false teeth that they "should use only mask type breathing apparatus".

An orienting lung ventilation and function test is required (vital capacity 1-2nd-value).

An ergometric test set at maximum capacity is to be carried out as a supplementary heart and circulation test.

The ergometric tests are to be conducted and assessed according to the latest medical finding. (For commentary, see Appendix).

The examining doctor must note in the medical certificate if he observes that the examined member is considered unfit: "rejected for health reasons". New appointment after ... after a period of time set by the doctor. During this time, the member must take part in an endurance training program.

The commander is to be informed of the test results.

Equipment maintenance persons are to be tested for the presence of respiratory tuberculosis and contagious skin diseases.

After an illness that seriously impaired his physcial fitness, a brigade member is to be medically re-examined to determine if he is fit for mine brigade service. He may resume his duties with the mine brigade only after he has been declared unconditionally medically fit.

Time Periods for Subsequent Re-Examinations

- Up to forty years of age	every 2 years
- Forty years of age and over	each year

(unless the examining doctor stipulates that more frequent examinations are necessary).

Equipment maintenance persons who are not, at the same time, regular brigade members are exempt from this rule.

Brigade members and leaders must retire from the brigade when they are 51 years of age.

(Excerpt from the design of Mine Rescue Organization)

D3 Anti-gas Protection Brigade (with the exception of equipment maintenance persons

In comparison to the mine brigade, the anti-gas protection brigade duty generally involves less physical and physological stress. This is to be taken into account in the assessment.

Persons whose body weight exceeds their ideal weight by more than 30 percent are generally not suitable. The examining doctor may disregard this rule if he deems it justifiable on the basis of the other test results.

The ideal weight is calculated using the Brocka (height in cm minus 100).

An orientating lung ventilation and function test is required (vital capacity 1-2nd-value).

An ergometric test set at sub maximum capacity is to be carried out as a supplementary heart and circulation test.

The ergometric tests are to be conducted and assessed according to the latest medical findings (For commentary, see Appendix).

The examining doctor must note on the medical certificate if he observes that the examined member is considered unfit: "rejected for health reasons. New appointment after ... (after a period of time set by the doctor). During this time the member must take part in an endurance training program."

The anti-gas protection brigade leader is to be informed of the test results.

Equipment maintenance persons are to be tested for the presence of respiratory tuberculosis and contangious skin diseases.

Time Periods for Subsequent Re-Examinations

Equipment maintenance persons who are not, at the sime time, regular brigade members are exempt from this rule.

After an illness which seriously impaired his physical fitness, a brigade member is to be medically re-examined to determine if he is fit for brigade service. He may resume his duties with the anti-gas protection brigade only after he has been declared physically fit.

Anti-gas brigade members - with the exception of equipment maintenance persons - must be retire from the brigade when they are 61 years of age.

- up to 50 years of age	every 2 years
- 51 years of age and over	every year

Unless the examining doctor stipulates more frequent examinations are necessary.

November 24, 1981

Endurance Capabilities of Mine Brigade Members

1. Modern life styles and the decline of manual labour has lead to a wide spread lack of physical exercise upon the general populous.

   This has resulted in a general lessening in endurance capabilities. Although this is neither particular to or typical of mine brigade members, mine brigade members are not excluded from the general trend.

   Accordingly, weaknesses of this type have been observed on brigade members over the last few years.

   These weaknesses occurred during operations - especially during the descent of shafts - during drill in the shaft installation as well as the headquarters for the mine rescue organization.

   The observed cases of unfitness constitute a considerable risk for the brigade members involved as well as for other section members during emergency situations.

2. Determining and Controlling Endurance Capabilities

2.1 Medical Suitability and Control Examination

These examinations are carried out in accordance with Paragraph 66 of the Pitcoal Mining Regulations.

Accordingly, members of the mine brigade - with the exception of equipment maintenance persons who are not, at the same time, regular members of the brigade - are to be examined at intervals of 2 years as well as after any long or serious bout of illness, to determine if they are fit for service. Mine brigade members who are older than 40 years of age are examined yearly.

Ergometric tests conducted are to be carried out according to the new regulatory procedures for medical examinations which are presently being revised. Additional examinations which take place between the usual intervals of examinations may be conducted according to the discretion of the staff doctor.

2.2 Through Assessment by the Mine Brigade

Further ongoing assessments of physical fitness take place during the routine mine brigade drills (5 to 6 times a year). These drills are conducted either as long drills underground or as 2 hour long drills in the drill area above ground.

Further fitness testing is done before these drills or in combination with them. The testing is supervised by the commander or someone authorized by him. The testing is carried out on an ergometric bicycle with an automatic heartbeat recording device. The results are entered into a formula and recorded in charts for each individual for the purpose of comparison (for internal use).

Mine brigade members who fall below the standard of any of the fitness tests are required to give proof of their fitness at times between the official brigade drills.

The commander or his authorized deputy is responsible that the maximum heartbeat frequency is not exceeded when endurance testing is carried out on the ergometric bicycles. Furthermore, he is responsible that the apparatus are in good working order.

Assessments of the fitness for duty of the mine brigade members are based on the results of fitness tests as well as on the member himself feels well at the time of duty.

The commander is responsible for arranging an appointment with the staff doctor for any brigade member who does not feel well or who displays poor physical condition.

3. Training

Mine brigade members should take advantage of any opportunity to improve their physical fitness. The training guidelines worked out in the pilot study at the National Sport Institute in Cologne should be given special consideration; because with this program not only muscular and circulation are markedly improved but also the economy of movement.

4. Cooperation

In order to achieve the desired improvement of the endurance capabilities of the mine brigade members, there must be close cooperation between the mine brigade and the staff doctor. The staff doctor may either personally conduct the endurance testing for supervise the testing.

APPENDIX IV
MINE RESCUE
OUTSIDE CANADA

SECTION 4.4

PART B

COPY OF FRANZ-JOSEF KOCK'S PAPER "USEFULNESS OF EXPERIENCE FROM EMERGENCY SITUATIONS AND EXERCISES, FOR THE WORK OF MINE RESCUE TEAMS".

(Presented at the International Symposium on Crisis Management, Sydney, N.S. October 1982).

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USEFULNESS OF EXPERIENCE FROM EMERGENCY SITUATIONS AND EXERCISES FOR THE WORK OF MINE RESCUE TEAMS

Presentation at the
International Symposium on Crisis Management,
in Sidney, Nova Scotia, Canada
on October 19, 1982

Contents | page

1. Hard Coal Mining in the Ruhr Coalfield . 3
2. Mine Rescue Centre in Essen 3
3. Mine Rescue Teams 4
4. Mine Rescue Team Actions and Firecontrol 5
5. Firefighting by Means of Nitrogen 6
6. Scheme of a Rescue Action 8
7. Responsibility for Rescue Actions 8
8. Alarm Scheme [illegible]
9. Management of Rescue Actions 9
10. Communication Systems Used by the Emergency Management 10
11. Scheme of Mutual Assistance 11
12. Fresh-Air Base 11
13. Duration of Rescue Actions in Humid and Warm Mine Air 12
14. Equipment for a First Emergency Intervention 13
15. Telephone Systems for Rescue Squads 13
16. Oxygen Self-Rescuers 14
17. Flame-Resistant Garments 15
18. Manual Measuring Devices 16
19. Physical Perseverance 16
20. Examinations by the Services of Occupational Medicine 17
21. Exercises at Surface Facilities, Including Perseverance Exercises 17
22. Checking of Physical Condition 17
23. Training 18
24. Manriding Facilities in Mine Rescueing 18

Bibliography 20

Drawings and pictures Nr. 1 - 28 22 and following pages

List of Slides

1. Coal-Measures in the Federal Republic of Germany
2. Organizational Structure of the Mine Rescue Centre in Essen
3. Number of Mine Rescue Operations (1961 until 1981)
4. Number of Inertation Operations and Nitrogen Consumption
5. Explosion Diagram
6. Sealing-Off and Inertation of Workungs
7. Inertation of Objects
8. Stepwise Recovery of a Fire Zone
9. Duties of the Management of Rescue Actions
10. Communication Systems of the Management of Rescue Actions
11. Information and Command Lines from and to the Fresh-Air Base
12. Schematic Organization of a Fresh-Air Base
13. Duration of Action by Mine Rescue Teams in Wet and Warm Air
14. Equipment for the First Emergency Intervention
15. Mine Rescue Telefone I (drawing)
16. Mine Rescue Telefone I (photo)
17. Mine Rescue Telefone II (drawing)
18. Mine Rescue Telefone II (photo)
19. Oxygen Self-Rescuer of Type Auer-SSR 120 (Size Category K 90) under Trial
20. Mine Rescue Team Starting out from the Fresh-Air Base
21. Manual Measuring Devices and Portable Measuring Instruments
22. Characteristic Perseverance Values of 300 Members of Mine Rescue Teams
23. Occupational - medical Examination of Mine Rescue Members
24. Mine Rescue Team on Training Bicycles
25. Perseverance Chart
26. Perseverance Run
27. Travelling in Drifts by Mine Rescue Teams

Usefulness of Experience From Emergency Situations and Exercises for the Work of Mine Rescue Teams

1. Hard Coal Mining in the Ruhr Coalfield

Fig. 1 In 1981 the Federal Republic of Germany produced 88 million tons of saleable hard coal of which 72 million tons came from the Ruhr and the Ibbenbueren coalfields. The Mine Rescue Centre in Essen is responsible for these two coalfields including 28 mines plus 1 rock salt mine. The total underground work force employed is 90 000 miners. The coal stems from 183 faces producing daily 1500 t as an average. The average-sized mine with a daily saleable output of 10 000 t (mean dirt percentage 45 %) thus has 6 or 7 operative coal faces. The performance per manshift is about 4 t. The average mining depth comes to almost 900 m and the mean coalbed thickness worked to 1.80 m. The normal methane emission is 10 m^3 per ton of coal extracted, with peak emissions as high as 90 m^3.

2. Mine Rescue Centre in Essen

Fig. 2 The Mine Rescue Centre in Essen was founded in 1910 by the mining companies of the Lower Rhenish-Westphalian coalfield. Today the Centre is a department of Bergbau-Forschung GmbH, the research establishment of Steinkohlenbergbauverein.

The main duty of the Centre is the improvement and management of mine rescue services. Changes in the structure and technology of the coal industry brought about a stepwise enlargement of its original duties.

3. Mine Rescue Teams

The establishment of a mine rescue team at each coal mine has been imposed by the mining authorities. Membership to a rescue team is voluntary. In the Ruhr coalfield there are 36 mine rescue teams ready for action, totalling some 3000 members or 3.3 % of underground work forces.

Each mine rescue team -- of normally 80 members -- is headed by an overman who, considering emergency requirements, is assisted by at least three deputies. Each team comprises at least 10 groups consisting of a group leader and four group members. There are about 3000 apparatus attendants to keep the extensive equipment -- among other 1600 circuit apparatuses with 400 l of oxygen reserve -- in working order. 75 % of the team members are equipped with ultra-short wave alarm receivers. On an average 15 minutes will elapse between an alarm and readiness for action, which means that at any moment two mine rescue groups or ten people can be set to work, fully equipped, in less than 30 minutes.

The overman is supported by engineers of the Mine Rescue Centre to help him in his complex duties. In cases of mine accidents they accompany the rescue teams to the underground to contribute their expert advice and practical help. Within the emergency management at the surface their expert competence will essentially bear on the course of any rescue action.

4. Mine Rescue Team Actions and Firecontrol

Fig. 3 The mine rescue team intervenes after explosions as well as in case of mine fires and other events where hazards may occur due to noxious gases or lack of oxygen. Rescue teams within the area of the Essen mine rescue centre had to intervene 838 times during the past 20 years, which means 42 times per year as an average. In recent years mine fires due to spontaneous combustion became less frequent. The present mine fire index is 0.1 fires per million tons of annual coal output. Bigger open mine fires did almost not occur any longer, this thanks to massive efforts to improve fire protection. The transformation to self-extinguishing fabric conveyor belts which had started in 1975, was completed last year. The proportion of steel-reinforced conveyor belts of identical properties amounts to some 50 %. Timber consumption in mines, having been of 21 solid cubic meters per 1000 tons of saleable coal output 20 years ago, has been cut back to 5 m^3. The use of hydraulically setting construction materials has increased to about 1 million tons per year, i.e. doubled, between 1977 and today. Roadside stoppings are the general standard of any modern face. They have in many instances proved their usefulness as a prerequisite for effective suppression of spontaneous combustion in the goaf. Premature warning of underground work forces is ensured by a dense network of CO recorders (more than 1100) and of modern communication systems. 21 of our mines use processors for a premature identification of mine fires

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5. Firefighting by Means of Nitrogen

Fig. 4 It was in December 1974 when for the first time in West German hard coal mining liquid nitrogen was evaporated at the surface and introduced, at a rate of approximately 60 m^3/min, to an underground fire zone. Thence developed a standard procedure of mine firefighting, -- procedure which was applied in 58 emergencies through 1981. With a nitrogen consumption of some 165 million m^3 it allowed to save 50 face equipments plus a daily output volume of approximately 50 000 t.

Fig. 5 The objective of mine fire inertization is to reduce the oxygen content of the mine air and thus avoid explosion hazards as well as to restrict the fire extension and intensity. To make a methane/air mix inexplosible one has to bring its oxygen content down to less than 12 % by volume. This is also sufficient for an open flame fire to extinguish. To fight spontaneous combustion fires successfully the oxygen content has to be diluted to less than 3 %. Moreover, for interventions in warm underground pits the supply of cold and dry nitrogen alleviates the working conditions for rescue men. And, in particular cases, explosible methane/air mixes can be safely flushed out by nitrogen. The latter procedure was applied after an explosion at the underground of the Hansa hydromine in 1979.

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Cig. 6 For inertization of a fire zone one starts by filling with nitrogen a zone which has been isolated on at least one side. The procedure is applied predominantly for fighting open fires or, in case of deep-seated fires, for eliminating explosion hazards in the caving area.

Fig. 7 For object inertization the seat of a fire is directly flooded with nitrogen. This serves to replace the stray ventilation current supporting a deep-seated fire as completely as possible by inert gas. The nitrogen volume flow requirement will normally be lower than for inertization of a fire zone.

A deep-seated fire will almost never be definitely extinguished by the introduction of nitrogen. Thus conventional sealing is still necessary. Even with an open mine fire direct firefighting and cooling will have to be applied starting already during the inertization procedure.

Inertization has invalidated the previously clear distinction between sealing-off and reopening of fire zones. Nowadays there is a gradual transition between the two phases. Time-saving may, when an underground area is to be recovered, be of vital importance to a mine.

Fig. 8 A long and auxiliary-ventilated roadway which in 1982, after gas ignition with ensuing fire, had to be isolated initially at the starting point of the auxiliary ventilation, could be recovered section-wise thanks to the introduction of nitrogen and notwithstanding difficult conditions of climate. To the effect the mine rescue team erected five temporary mine air seals spaced at still acceptable distances so that after flushing of each section the starting point for erecting the next seal could be advanced.

Thanks to steady progress in technology, organization, and logistics it is possible, nowadays, to apply the procedure anywhere in our coalfield within less than twelve hours.

6. Scheme of a Rescue Action

Explosions, mine fires, roof breaks in coal faces and roadways, water inrushes, and similar events, require concertated and immediate efforts in order to rescue the miners affected. The entire package of organizational and technical actions to be taken in these emergencies are laid down in a relevant scheme. It is basically followed also for any other major interventions by mine rescue teams.

The scheme settles among other things:

- Warning of the persons to be involved in the rescue action;
- immediate actions to be taken by the temporary head of the emergency management;
- the duties of the emergency management;
- the duties of the other persons involved.

7. Responsibility for Rescue Actions

As of January 1, 1982, has become effective a new Federal Mines Act according to which the operator of a mine or the responsible persons entrusted by him have to take any measures apt to eliminate hazards or to rescue victims. This means that the Mines Inspectorate will no longer be the sole responsible for managing rescue actions although it may -- as the case may be -- direct the necessary measures.

8. Alarm Scheme

The warning centre receives instruction to give alarm either from the mine management or from the supervisor on charge. In an extreme case any miner telephoning directly from the endangered zone may initiate the warning procedure. The advantages of ultra-short wave radio systems have proved to be valuable, indeed, for warning mine rescue team members. We therefore scaled the system up to create an emergency radio communication system for the mining industry which allows to warn a larger number of persons.

9. Management of Rescue Actions

Fig. 9 Until formation of the management for mine rescue actions, the temporary head of the emergency management initiates any instantaneous measures required. The mines maintain a permanent stand-by service for the persons concerned. The temporary head of the emergency management is not allowed to go underground in case of alarm.

Independent of any legal considerations any and all actions are directed by a work team called management of rescue actions or emergency management. Representatives of the mining authorities, mine management, and Mine Rescue Centre closely cooperate in this management. If the latter is to function efficiently one should make sure that the group which theoretically consists of three men be by no means enlarged beyond a very restricted basis. The duties of the management are summarized in a check-list by subject matters. For major mine accidents the establishment of an information office has proven its usefulness. It is here where all the persons arriving later are supplied with preliminary information on the status of rescue actions. Associated to the emergency management is the necessary assisting staff which prepares decisions and pursues directed measures through to their completion. Any and all arriving reportings and outgoing instructions are noted down at the emergency management. The relevant minutes serve, among other, as a reference document for eventual investigations and evaluations. The minutes are meant, however, above all as a memo and should preferably be broken down by working units. The keeper of the minutes is to remind the management of actions due to be taken; he is supposed to cooperate actively instead of just writing.

10. Communication Systems Used by the Emergency Management

Fig. 10 The emergency management can function well only if all the information required is made available and if it is able to rapidly contact any agency concerned. Therefore an appropriate location has been provided and equipped with suitable means of communication among which: a two-way telephone system, a telephone where only calls from the underground can be received, a "red" telephone whose number is not made known, and a normal telephone set. There may be provided furthermore a monitor with plotter permitting to directly transmit and scan any desired measuring values from the control room. If nitrogen is used for firefighting and conditions are difficult, it is possible to transmit for instance pressure, temperature, and volume flow (sometimes these parameters may be remotely controlled).

In any case a special telephone line or radio language communication has to be installed between the inert gas plant and the emergency management.

11. Scheme of Mutual Assistance

Fig. 11 Notwithstanding the size and efficiency of our mine rescue teams it became obvious that major emergency situations can only be handled with the assistance of neighbouring teams. According to a scheme of mutual assistance, therefore, every mine may request four other teams to come and help. When several rescue teams are simultaneously active at one site, the emergency management will define and delimit the duties and responsibilities of each overman.

12. Fresh-Air Base

Fig. 12 During the first intervention of the mine rescue team a stand-by group stays behind at a "temporary fresh-air base" being in telephone communication with the emergency management. As soon as possible upon consultation with the emergency management one or more fresh-air bases will be installed. On the one hand a fresh-air base should be as near as possible to the site of intervention and, on the other hand, be at a safe distance from it. The overman supervises the fresh-air base. He reports directly to the emergency management. The first intervention normally serves for exploration and, thus, falls under the concept of "aggravated conditions". By aggravated conditions are understood underground workings

where humid and warm air, seriously reduced visibility, and sections difficult to travel through prevail. In these circumstances the members of stand-by groups, with oxygen breathing apparatuses worn on their backs, stay as close to the site of intervention as is possible without using the apparatus. This means that normally each fresh-air base is manned by three rescue groups.

13. Duration of Rescue Actions in Humid and Warm Mine Air

Fig. 13 Due to depth and degradation of climate by the fire, the normal two hours of action often cannot be held out. At temperatures of e.g. $t_d = 36^\circ$ C and $t_w = 32^\circ$ C the intervention is reduced to one hour. Then four groups are required to permanently man the site. If temperatures reach $t_d = 43^\circ$ C and $t_w = 38^\circ$ C, the action has to be reduced to as little as 20 minutes. In this case one even needs nine groups if gaps are to be avoided. Now, how many oxygen breathing apparatuses will be required for the groups in each of these three constellations? For three groups are required 17, for four groups 22, and for nine groups 32 apparatuses. In any case 12 oxygen breathing apparatuses remain at the surface rescue station. If the internal reserves of apparatuses are inadequate to maintain this number, additional units would be requested from one of the assisting neighbouring rescue teams.

14. Equipment for a First Emergency Intervention

Fig. 14 A good starting position for rapid first interventions has been created by keeping the equipment of the rescue teams ready in easily transportable dragging baskets at the mine rescue station. This basic equipment is only for first exploration and will be supplemented whenever firefighting or rescueing of men is directed. It is only when further groups are starting out for action that the material which is also kept ready for easy transportation to the fresh-air base, will be brought to the underground.

15. Telephone Systems for Rescue Squads

Fig. 15 Efficient information and communication between the advancing group and the fresh-air base is of critical importance to the safety of a rescue team. Here, intrinsically safe, sound powered telephone systems proved their usefulness. Language communication Fig. 16 is amplified in both directions by using a loudspeaker. The stand-by group, thus, gets detailed information on its duties ahead. For first interventions the advancing group carries one or more line cartridges (weighing 2.6 kg) of 400 m length each Fig. 17 which are fastened to the belt and unroll automatically. After the first intervention this delicate thin line will be replaced by a more robust flat-strand line equipped with interception pinches. Using these pinches the rescue group is able to "tap" the telephone line at any point between the site of intervention and the fresh-air base. The loudspeaker is of a portable type (weight 7 kg) and is taken along to the site also for stationary

Fig. 18 work. Trials on radio sets for language communication indicate that such system may also be of use for some aspects of mine rescue actions. On the other hand it is impossible to replace the present mine rescue telephone systems I and II completely by radio systems, at least for the time being. And it has been demonstrated in many instances that one should by no means renounce at such valuable means of perceiving also all the side-noises, even breathing noises of the telephone mask user. In some rescue actions where visibility was severely reduced the telephone line really was a kind of Ariadne's thread and helped the rescue group to get out again.

16. Oxygen Self-Rescuers

Fig. 19 Every rescue group takes along at least one oxygen self-rescuer. When men have to be rescued oxygen self-rescuers may also serve them provided that the persons concerned are still capable of breathing by themselves. Mine rescue teams have been equipped for many years now with Oxy-SR 45 oxygen self-rescuers by Draeger. One of these days will commence delivery some 400 oxygen self-rescuers of type Auer-SSR 120 (size category K 90) which are to be fullscale-tested both in normal and in mine rescue conditions.

As is known, for the first time in 1951 all the miners of one colliery in the Ruhr coalfield were equipped with filter self-rescuers. Until 1981 more than 6500 filter self-rescuers were used in 509 escape situations. 25 % or some 1600 miners were highly probably saved from serious to fatal CO intoxication. Nowadays all the mines are equipped with such devices whose service duration safely covers the maximum admissible escaping time of 90 minutes. For the sake of a uniform escape scheme are being tested, therefore, exclusively oxygen self-rescuers for a minimum duration of 90 minutes (tidal volume of 35 l/min). It is intended to introduce them:

- in unusually long auxiliary-ventilated roadways;
- in auxiliary-ventilated roadways where Diesel-powered, rubber-tyred vehicles are used, and
- in workings prone to gas eruptions.

The new oxygen self-rescuers of extended service duration are to be used also as auxiliary devices for mine rescue teams as well as for rescueing of men and should in the long run replace devices of shorter duration.

17. Flame-Resistant Garments

Fig. 20 In the case of one underground explosion back in 1965 it turned out that five members of a rescue team were fatally burnt although they wore regular flame-resistant garments. Prompted by these fatalities a procedure was developed allowing the direct assessment of heat effects on man. Several years ago improved flame-resistant garments were introduced whose protective effect is about twice as high as of previous fabrics. The outfit consists of underwear of a voluminous spongy fabric (495 g/m^2) and of a double-layer suit made from Nomex III (2 times 265 g/m^2) of antistatic properties. The flame-resistant suit is nowadays also worn as the normal working outfit of rescue team members. When explosion hazards prevail, protective hoods and gloves are worn as well.

18. Manual Measuring Devices

Fig. 21 Gas measuring techniques have gained increasing importance for the work of rescue teams. Not at least for their non-interference with ongoing inertization operations are in use, besides manual oxygen measuring devices, exclusively those types of manual and portable measuring instruments whose indications remain unaffected by lack of oxygen or whose cross sensitivity is easy to assess.

19. Physical Perseverance

Modern life style and the obsoleteness of physically exerting labour have resulted in a general restriction of physical mobility. This, in turn, leads to a reduced capacity of physical perseverance. The phenomenon is by no means specific to the mining industry nor typical for rescue team members but, unfortunately, applies also to them. We observed that rescue team members during their work -- and specifically when travelling through inclined workings -- as well as during their exercises showed increasing signs of physical deficiency.

Fig. 22 In 1978 we, therefore, determined the perseverance characteristics of 300 rescue team members by subjecting them to exercises on the ergometer bicycle. An inadequately trained physical condition was observed with 14 % of the men! 42 % only of the persons examined showed good or even excellent physical perseverance. The physical deficiencies stated will in an emergency situation not only endanger the individual in question but also the other group members. We, therefore, introduced four remedial measures:

- 20. Examinations by the Services of Occupational Medicine

Fig. 23 The regular ergometric examinations in the framework of check-ups by the services of occupational medicine are now carried out according to a uniform method. To the effect the rescue team members are subjected to maximum loads depending on their age and weight, i.e. the desirable heart frequency should be 200, minus age. Here, a physical performance should be achieved equalling three times the weight. If training is inadequate the persons are suggested a purposeful perseverance training.

- 21. Exercises at Surface Facilities, Including Perseverance Exercises

Fig. 23 The two hours of surface exercises were completed by a "perseverance" section which is focussed on the aspects force training, travelling, working, and includes a perseverance training of 15 minutes. For perseverance training are used the bicycles. The load, starting with 1.2 W times kg of body weight, is increased by two increments of 20 W each (sub-maximum load).

- 22. Checking of Physical Condition

Fig. 24 The same ergometer bicycle is used for checking the physical condition of the men, with monitoring of pulse frequency. The result is displayed as a characteristic value and plotted on a perseverance chart. This checking is also done at sub-maximum load. If a person shows physical deficiencies the overman will, as the case may be, have him examined by the services of

- 23. Training

Fig. 26

There are several kinds of activities apt to build up and maintain physical endurance. To the effect we established training suggestions containing practical instructions as to the frequency, intensity, and duration to be observed. We have not been successful so far in convincing all of the rescue team members of the necessity of a purposeful perseverance training. But nevertheless a major proportion of them accepted to do running exercises. Mine rescue teams promote this type of activity by arranging special running competitions where so far up to 500 rescue team members attended at one time. Some of the men also started to practice the fitness training recommended by the Royal Canadian Air Force. As a result of a pilot study by Ruhrkohle AG has been suggested to install locations equipped with isokinetic training devices. It had been demonstrated by a training program that not only the muscular condition and blood circulation but also motorial efficiency improved within a few weeks. Several collieries will provide such training rooms.

24. Manriding Facilities in Mine Rescueing

Fig. 27

As a consequence of lay-outs in horizon mining, concentration of several collieries in compounds, connection of new mine takes to existing collieries, and widely expanding introduction of belt conveying means, mine rescue teams were faced many times with difficult to solve problems. When doing exercises in

inclined drifts it became obvious that rescue men, even in a perfect physical condition cannot do without mechanical manriding facilities. All technical and organizational potentials should, therefore, be utilized to make available manriding facilities in good working order also in cases of mine fires or explosions.
In several instances operator stands or drives were either
transferred to the intake air side or designed in a way that
Fig. 28 they can continue operating also in emergency situations. In long
roadways with auxiliary ventilation rail bicycles are kept ready either for escape purposes or for advancing rescue groups. Battery-powered floor-bound transport means and suspended monorail trains lend themselves to rescue actions very well in so far as they can continue operating also in case of lacking oxygen. This advantage is felt particularly during inertization. Technical potentials in this field are, however, far from being fully utilized. Any future improvement should, more intensively than so far, be sought under the aspect of making escapes safer and improving mine rescue services.

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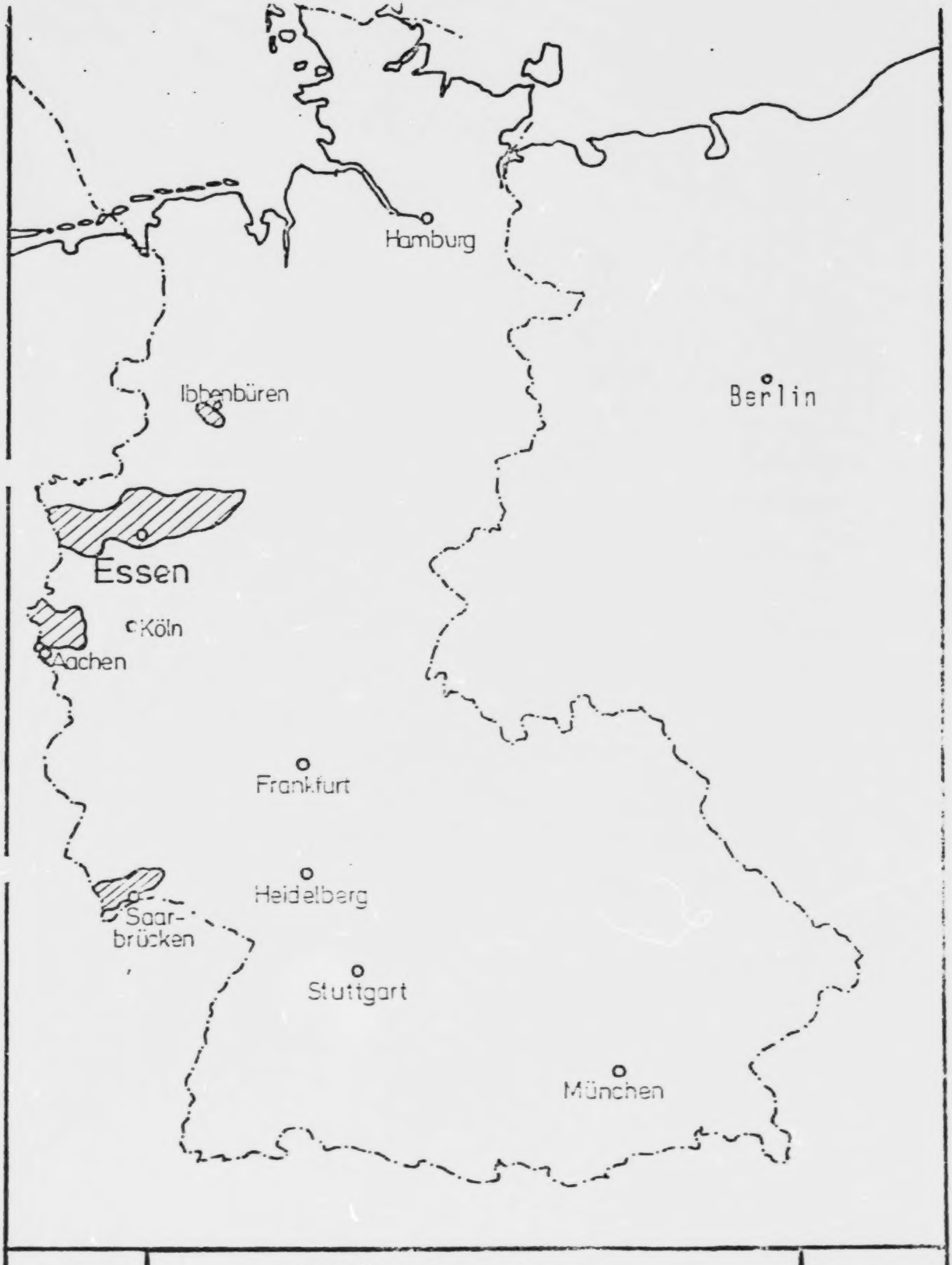
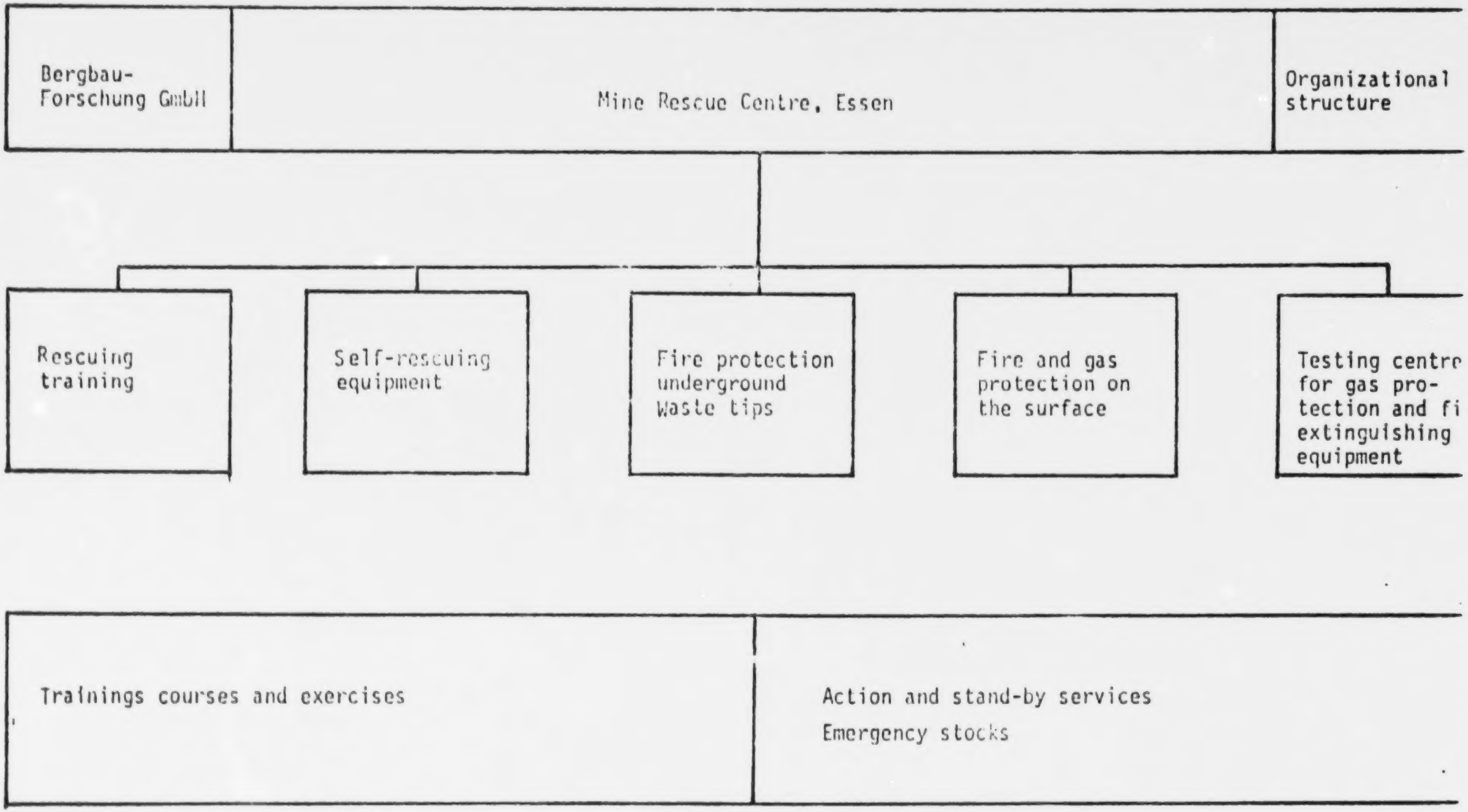

Hamburg
Berlin
Ibbenbüren
Essen
Köln
Aachen
Frankfurt
Heidelberg
Saar-
brücken
Stuttgart
München

1982

Coal-measures
in the Federal Republic of Germany

H GRWE



Bergbau-Forschung GmbH

Mine Rescue Centre, Essen

Organizational structure

Rescuing training

Self-rescuing equipment

Fire protection underground Waste tips

Fire and gas protection on the surface

Testing centre for gas protection and fi extinguishing equipment

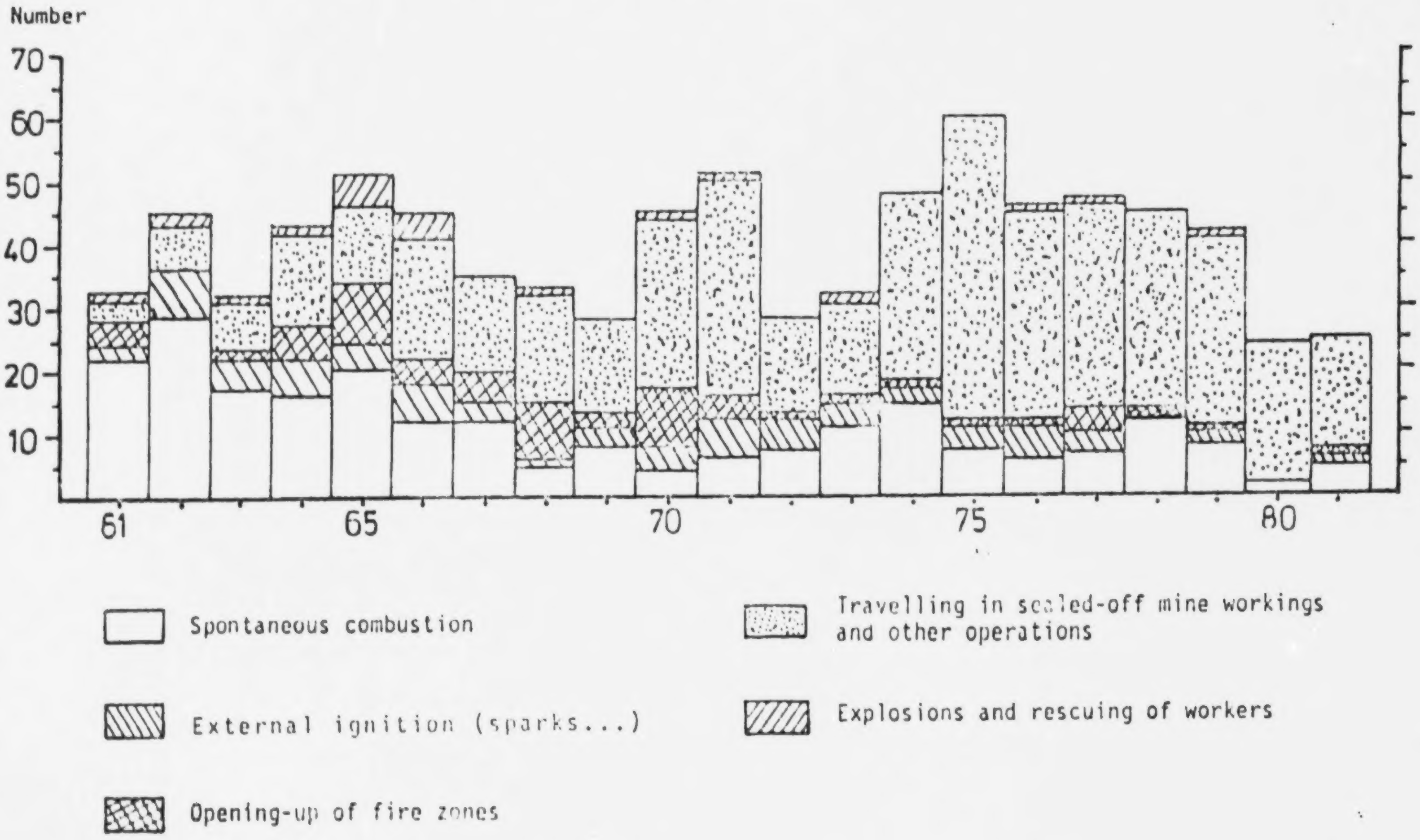
Trainings courses and exercises

Action and stand-by services

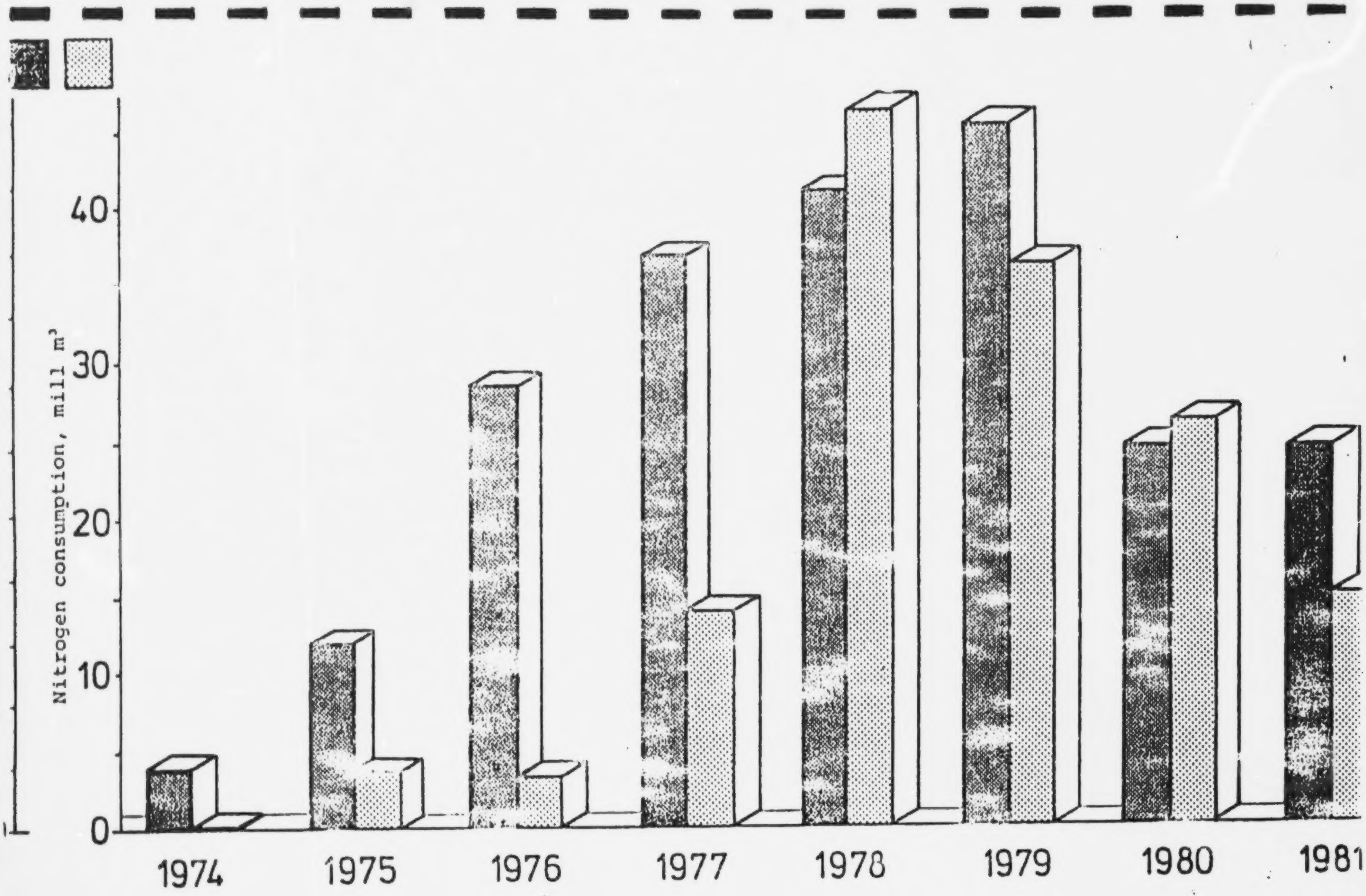
Emergency stocks

1982	Organizational structure of the Mine Rescue Centre, Essen	H GRW

Abb. 3

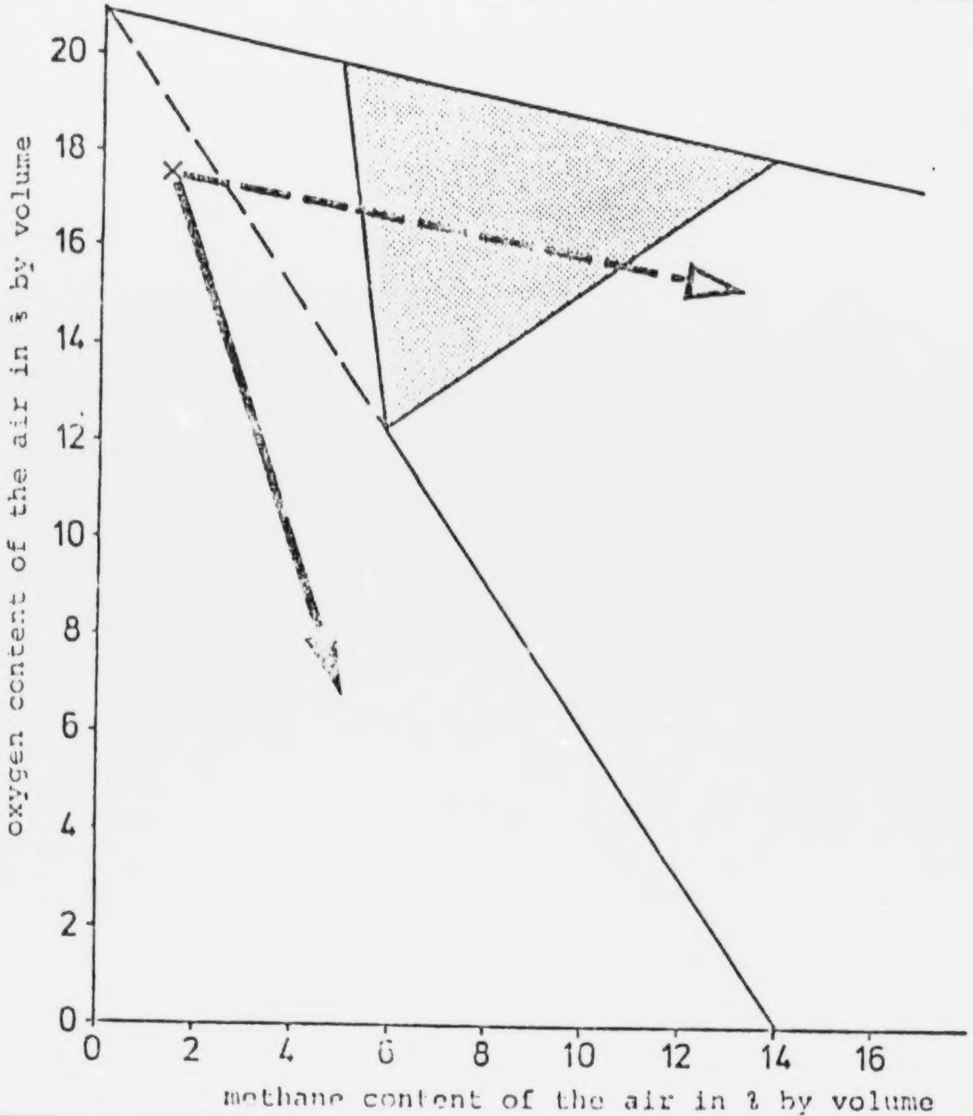


1982 | Number of mine rescue operations 1961-81 | HGRWE



82	Number of inertation operations and nitrogen consumption	HGF

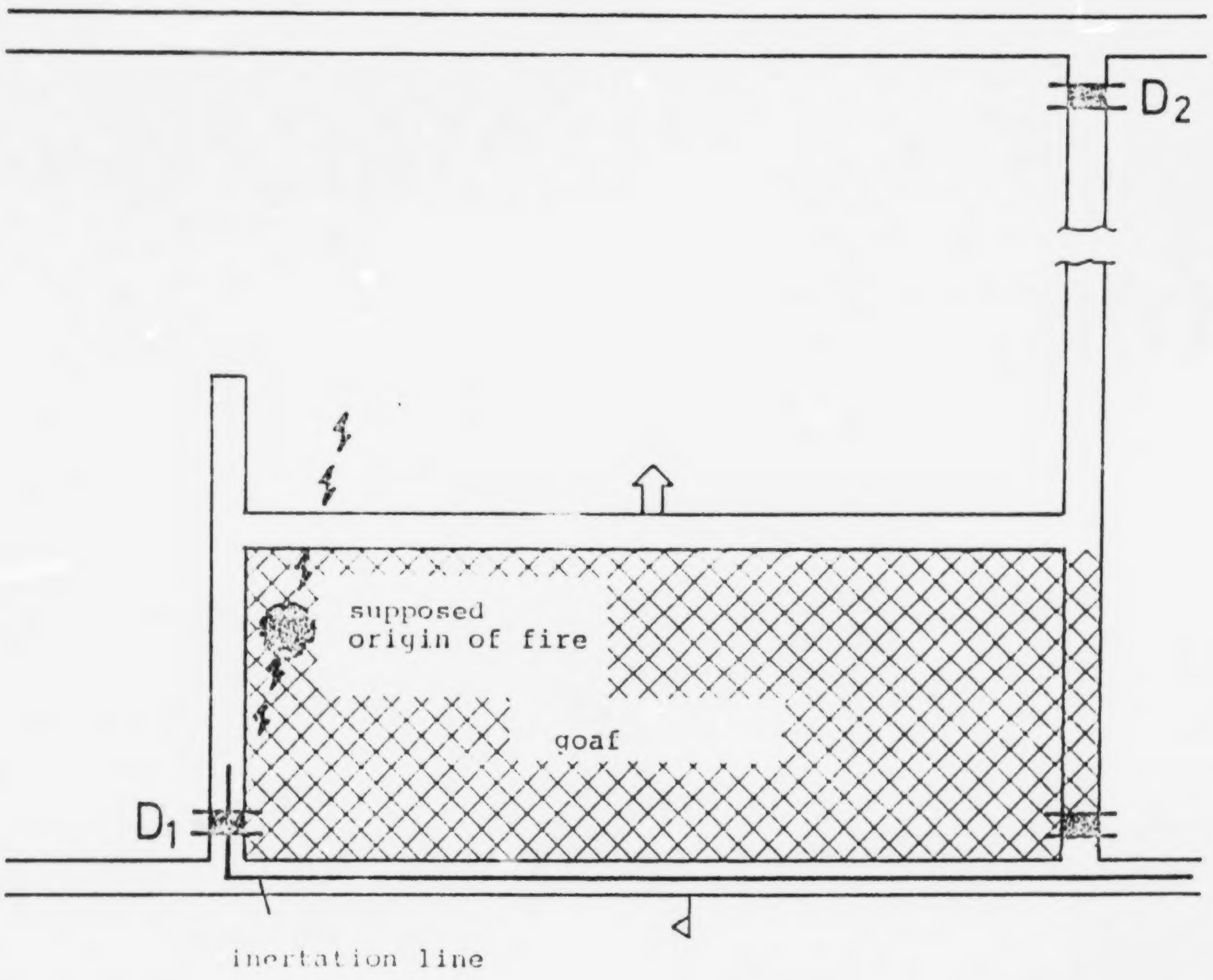
Abb. 5



1982

Explosion diagram

HGRWE

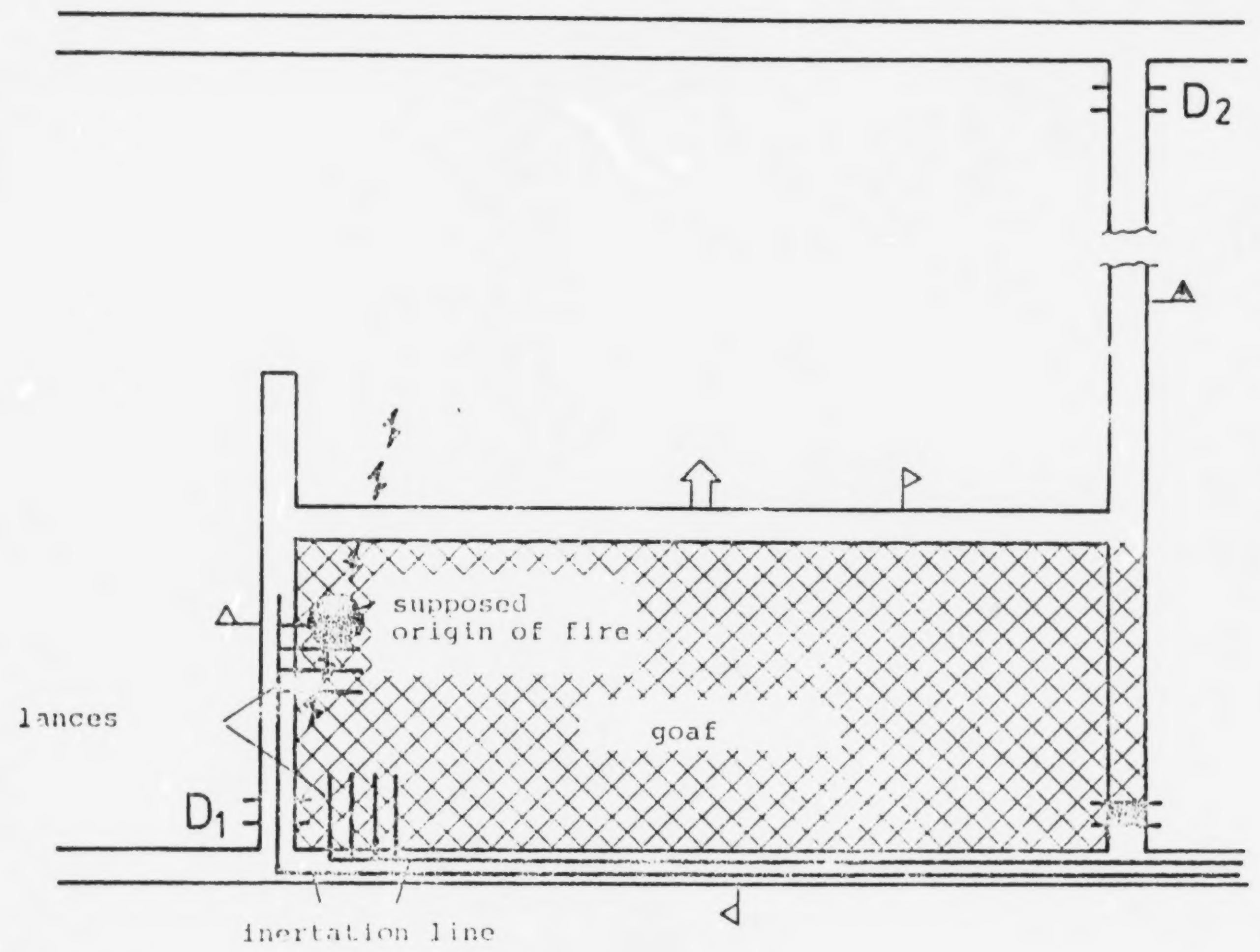


D2
supposed
origin of fire
goaf
D1
inertation line

1982

Sealing-off and inertation of workings

H GR


D2
supposed
origin of fire
lances
goaf
D1
inertation line

1932 | Inertation of objects | HGRW

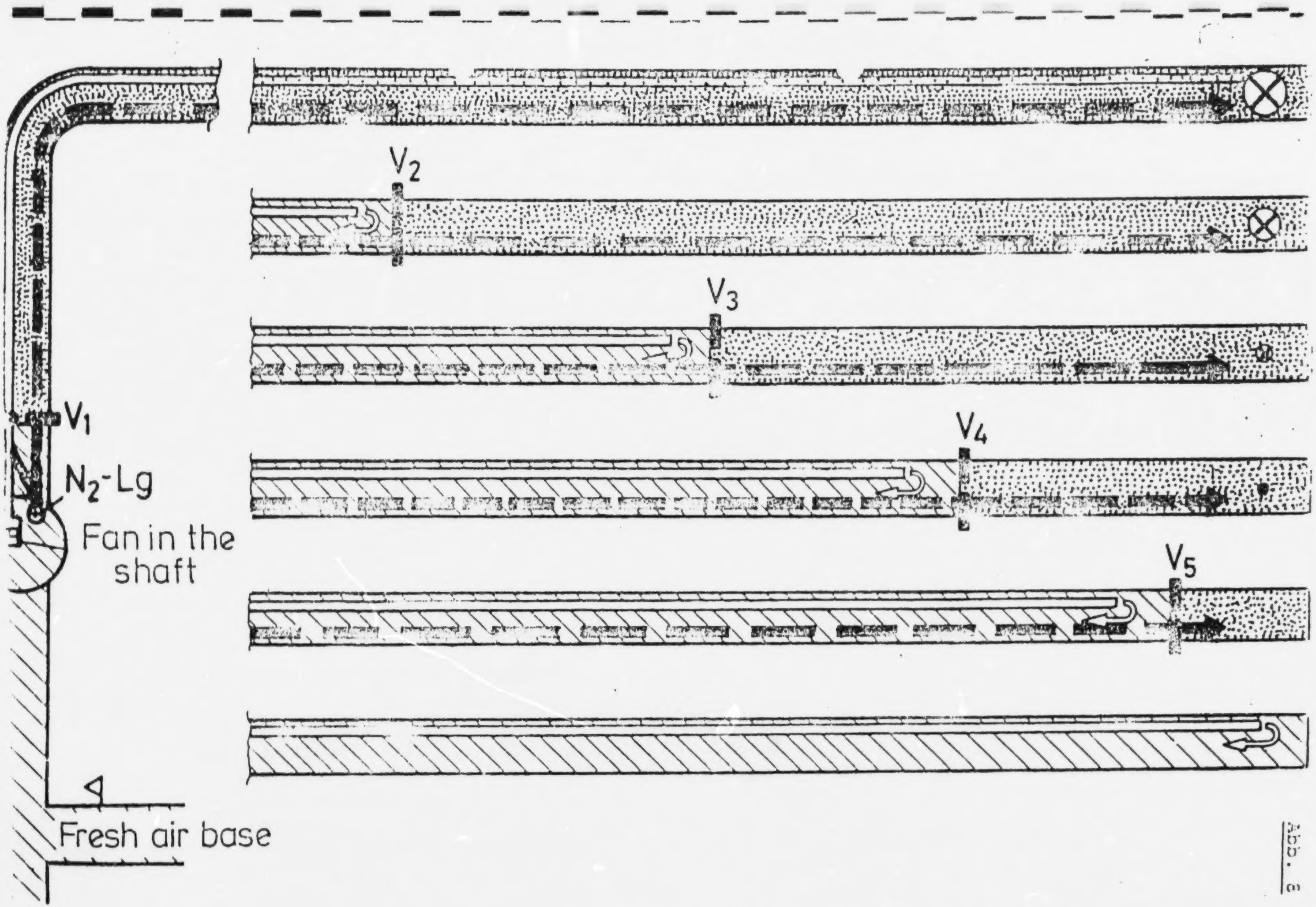

V1
N2-Lg
Fan in the shaft
Fresh air base
V2
V3
V4
V5

Abb. 8

982

Stepwise recovery of the fire zone

HGRW

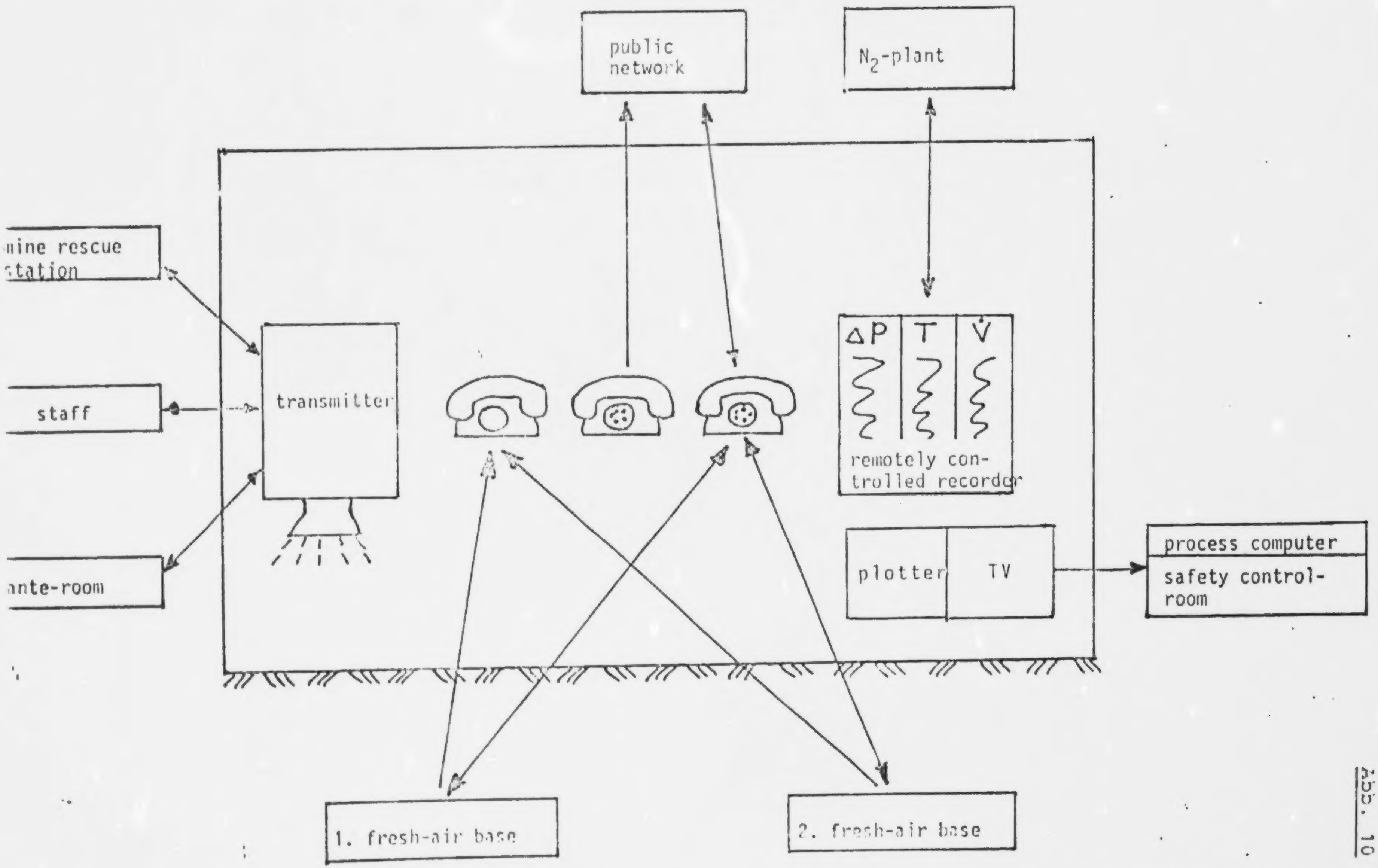
mine rescue	direction of ventilation	mechanical engineering	organization on the surface
workforce	fire fighting	electrical engineering	materials supply
records	mine surveying	public relations	medical support services

1982

[illegible] of the management of rescue actions

HGRI

Abb. 10

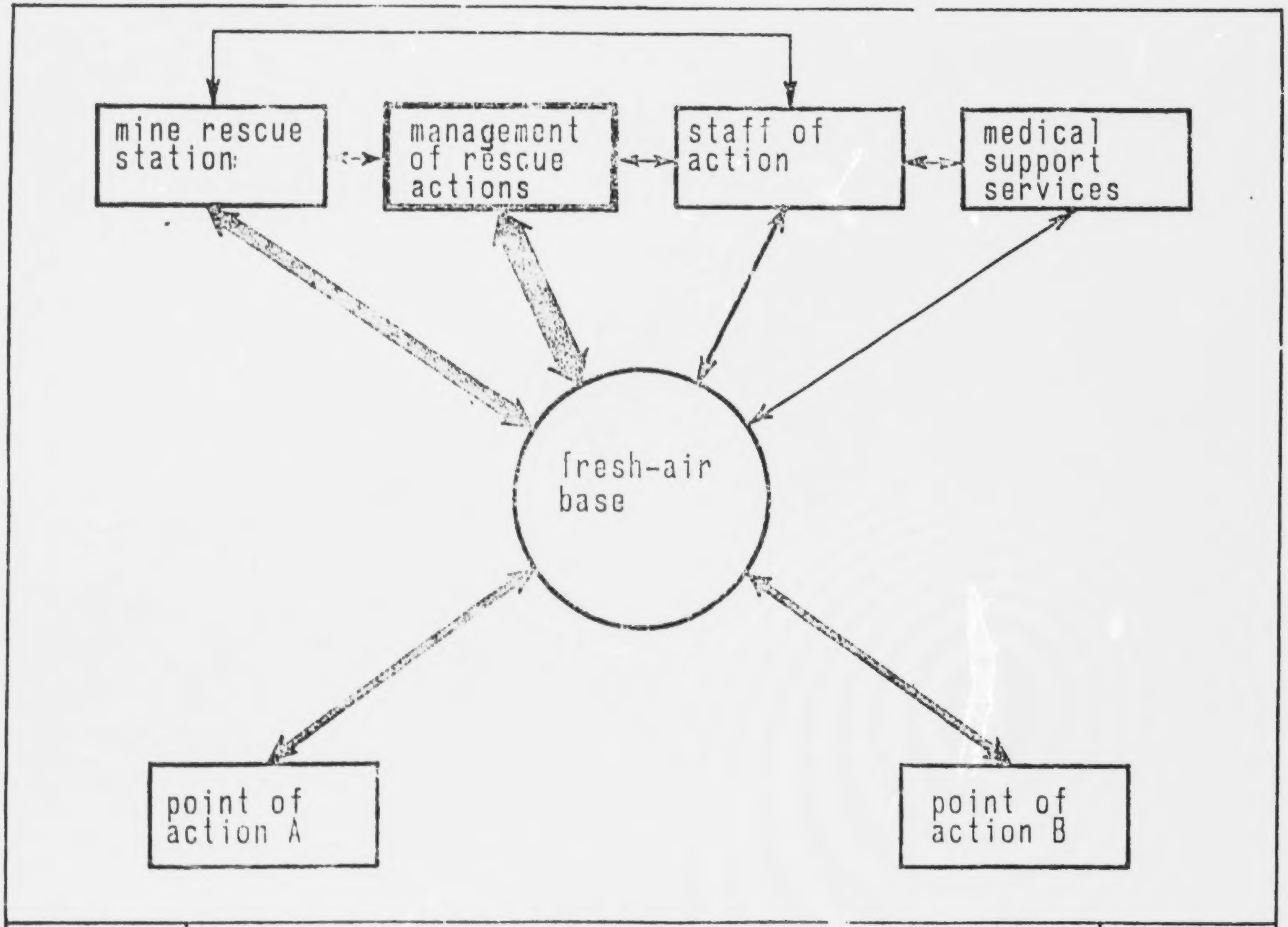

public network
N$_2$-plant
mine rescue station
staff
ante-room
transmitter
ΔP
T
V̇
remotely controlled recorder
plotter
TV
process computer
safety control-room
1. fresh-air base
2. fresh-air base

Communication systems of the management of rescue actions

1982

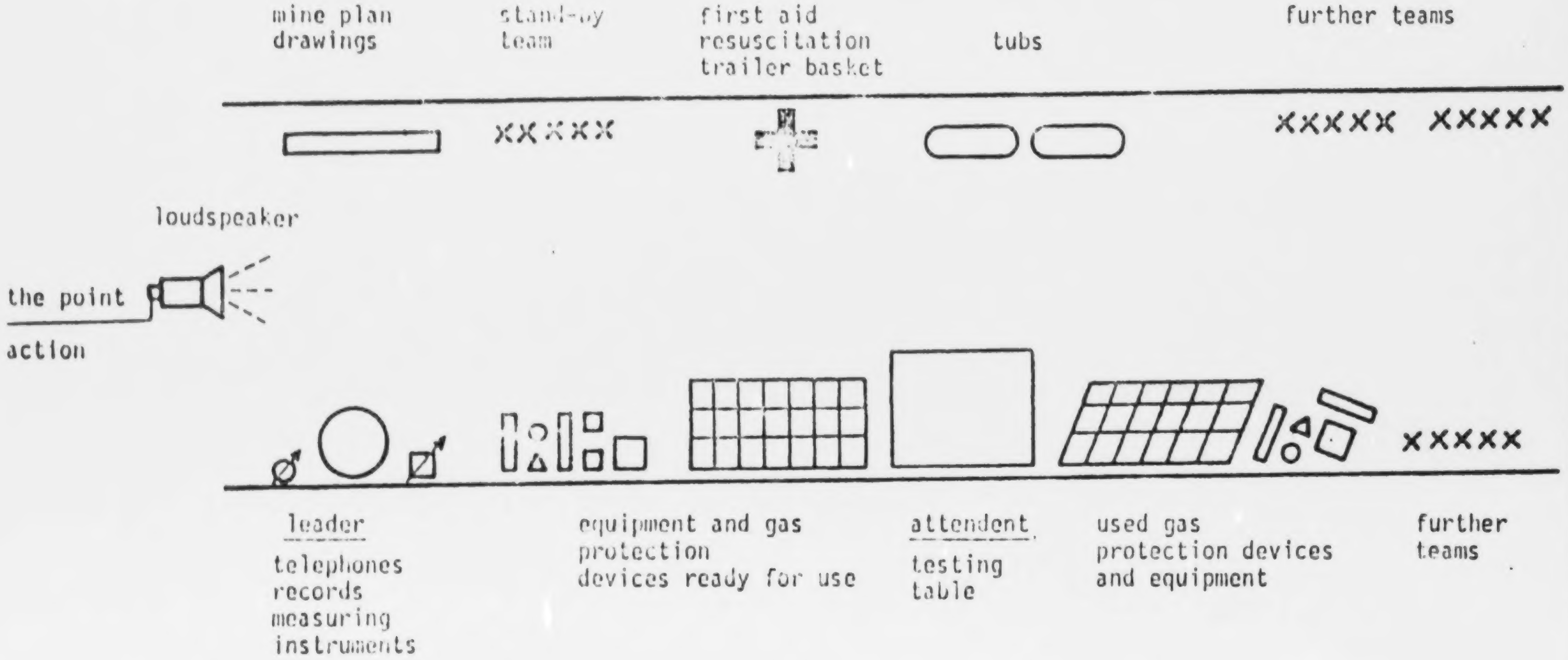
H GRW

Abb. 11


mine rescue station
management of rescue actions
staff of action
medical support services
fresh-air base
point of action A
point of action B

1982	Information and command lines from and to the fresh-air base	H GRW E

Abb. 12

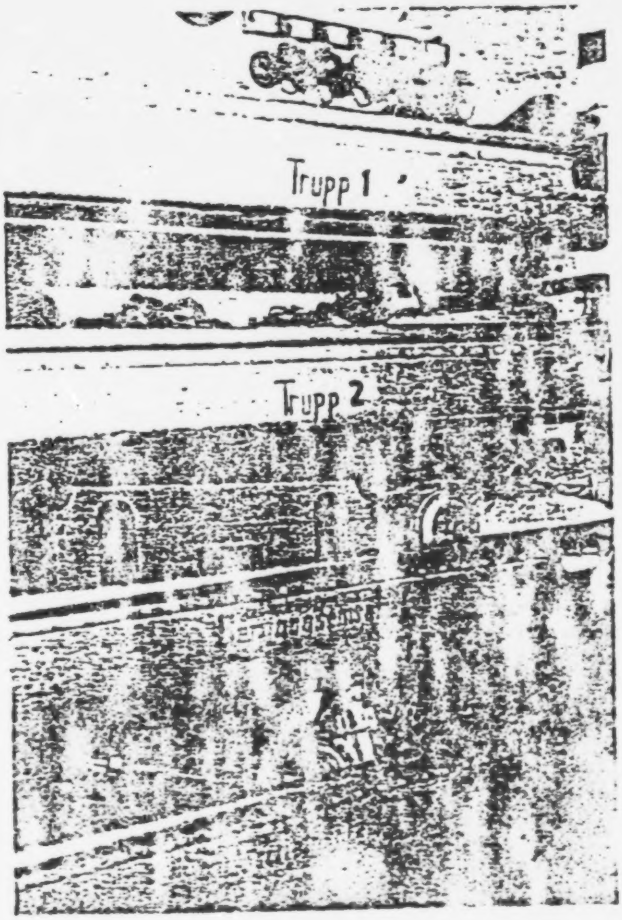

mine plan drawings
stand-by team
first aid resuscitation trailer basket
tubs
further teams
loudspeaker
the point
action
leader
telephones
records
measuring instruments
equipment and gas protection devices ready for use
attendent
testing table
used gas protection devices and equipment
further teams

1982	Schematic organization of a fresh-air base	H GRW E

wet bulb temperature t_f [°C]	duration of action in minutes for Δ t* below 5 °C	 for Δ t* 5 to 10 °C	 for Δ t* above 10 °C
29	90	85	80
30	80	75	70
31	70	65	60
32	60	55	50
33	50	45	40
34	45	40	35
35	40	35	30
36	35	30	25
37	30	25	20
38 - 40	25	20	15

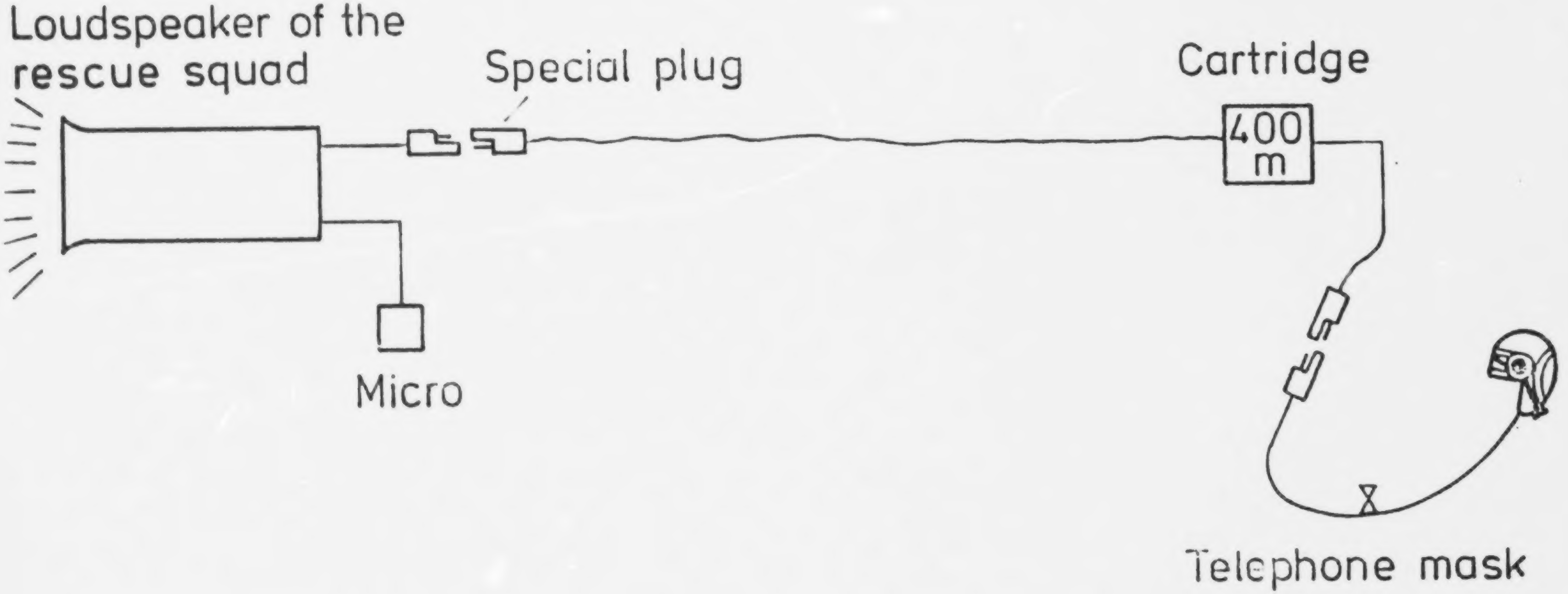
*Δ t = difference between dry bulb temperature (t_t) and wet bulb temperature (t_f)

1982	Duration of action by mine rescue teams in wet and warm air	H GI



Trupp 1
Trupp 2

1982	Equipment for first action by mine rescue teams	HGRWE


Loudspeaker of the rescue squad
Special plug
Cartridge
400 m
Micro
Telephone mask

Rescue base

Place of use

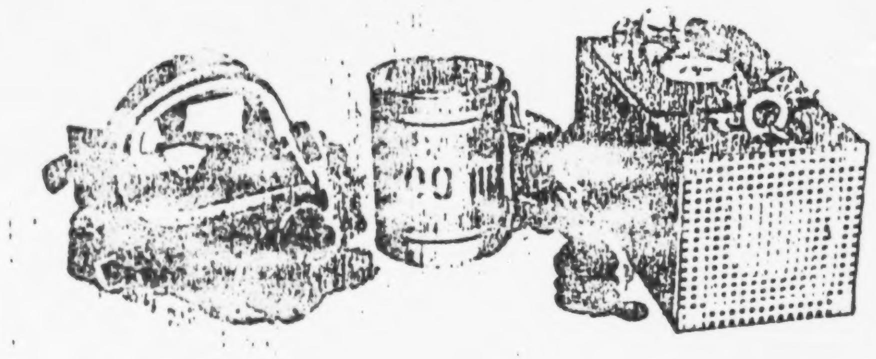
Rescue team operating under aggravating conditions during the first intervention

Abb. 15

Mine Rescue Telephone I

HGRW E

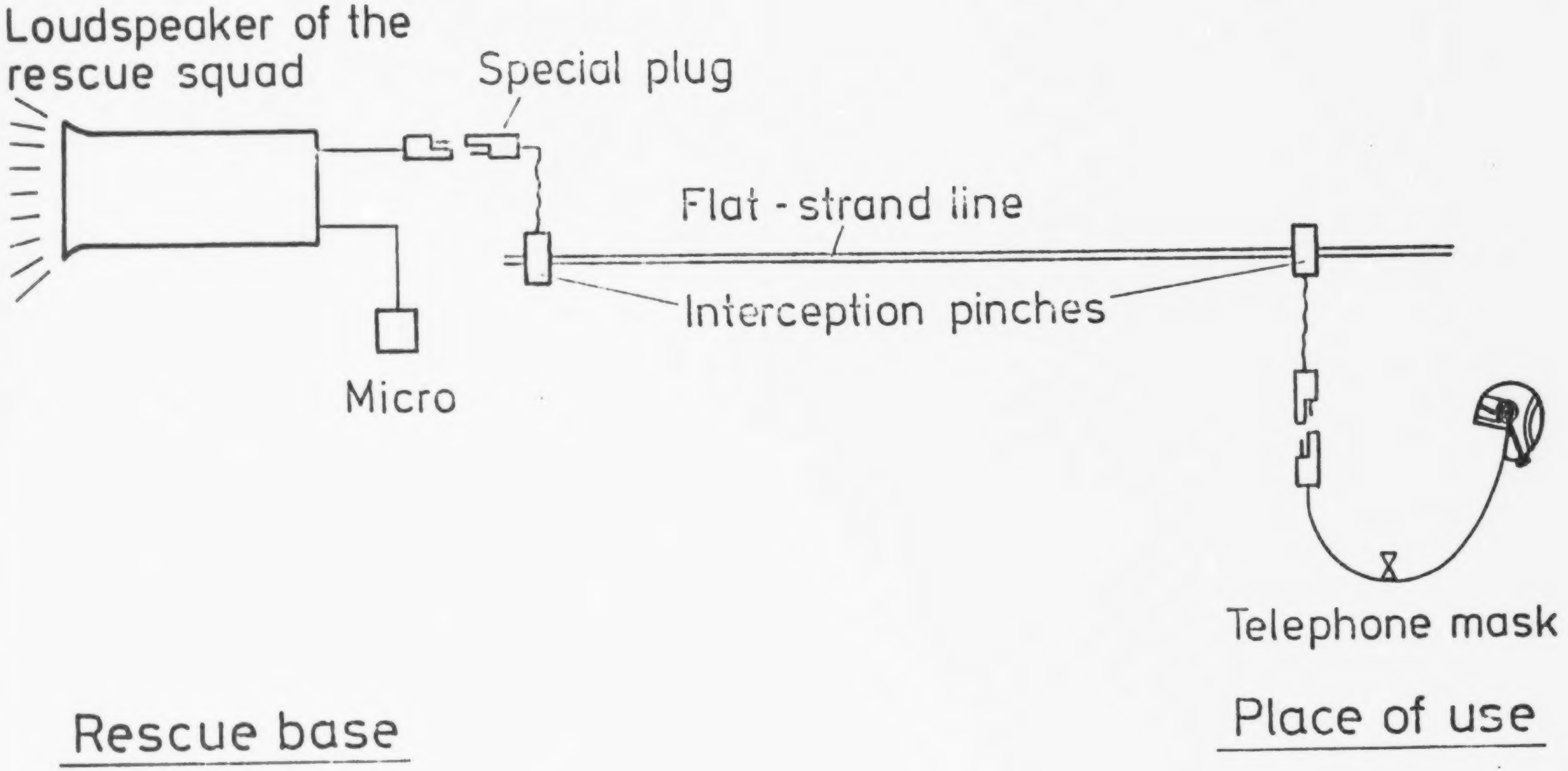
Abb. 16



1982

Mine rescue telephone I

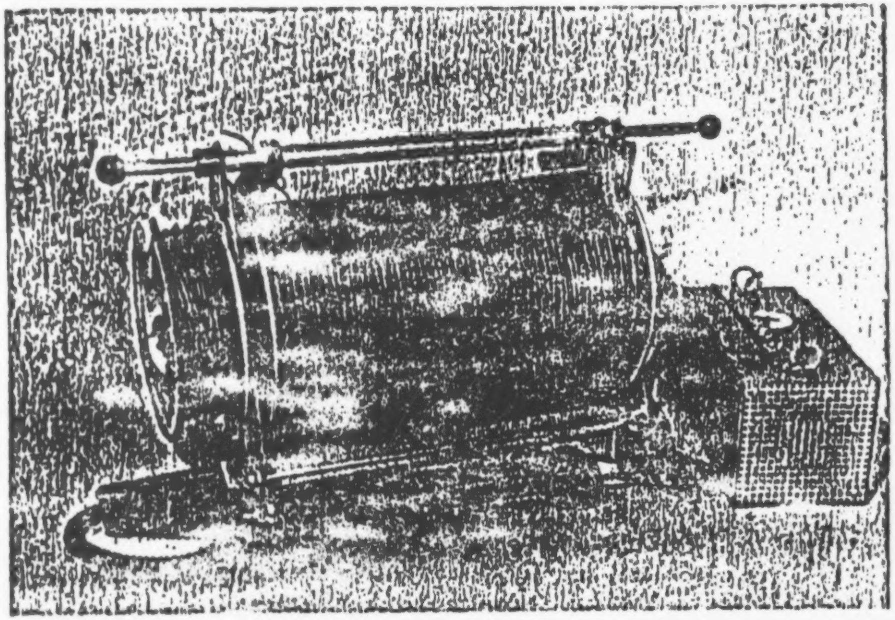
H GRWE


Loudspeaker of the rescue squad
Special plug
Flat - strand line
Interception pinches
Micro
Telephone mask
Rescue base
Place of use

Rescue team operating under aggravating conditions after the first intervention

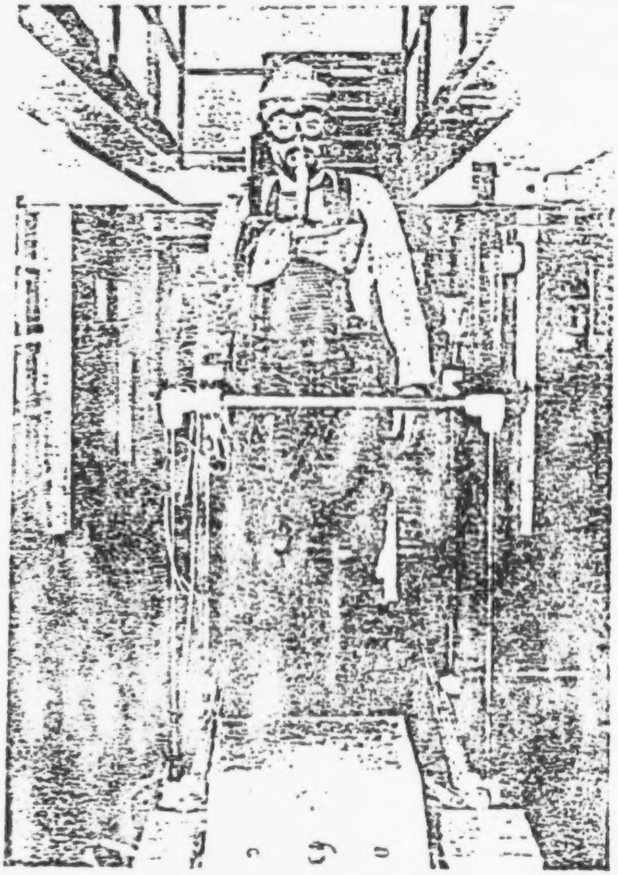
Abb. 17

Abb. 18



1982	Mine rescue telephone II	H GRWE

Abb. 19



Oxygen-self-rescuer type Auer SSP 120

Abb. 20

1982	Mine rescue team leaving fresh-air base	H GRWE

Abb. 21

manufacturer type	application	measuring range	measuring principle
Auer M 502	manual methane measuring device	0 - 2 % / 0 - 5 % CH_4	heating tone
Auer M 510 B	manual methane measuring device	0 - 100 % CH_4	thermal conductance
Auer A 2 WT	portable explosimeter measuring device	0 - 100 % UEG	heating tone
Auer Oxygen-Indicator	manual oxygen measuring device	0 - 25 % O_2	electrochemical detector
Dräger COMOWARN	portable CO-measuring devices	0 - 200 ppm CO 0 - 400 ppm CO	electrochemical detector
gas detector tubes	Auer / Dräger CO, CO_2 and others	different measuring ranges	chemical reaction (changing colour)

Manual measuring devices and portable measuring instruments

Abb. 22

characteristic value	classification	percentage
< 75	bad	14
76 - 100	moderate	44
101 - 125	good	35
> 125	very good	7

58 % (< 75 and 76 - 100)

42 % (101 - 125 and > 125)

Characteristic perseverance values for 300 members of mine rescue teams

Abb. 21

manufacturer type	application	measuring range	measuring principle
Auer M 502	manual methane measuring device	0 - 2 % / 0 - 5 % CH_4	heating tone
Auer M 510 B	manual methane measuring device	0 - 100 % CH_4	thermal conductance
Auer A 2 WT	portable explosimeter measuring device	0 - 100 % UEG	heating tone
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Manual measuring devices and portable measuring instruments

Abb. 22

characteristic value	classification	percentage	
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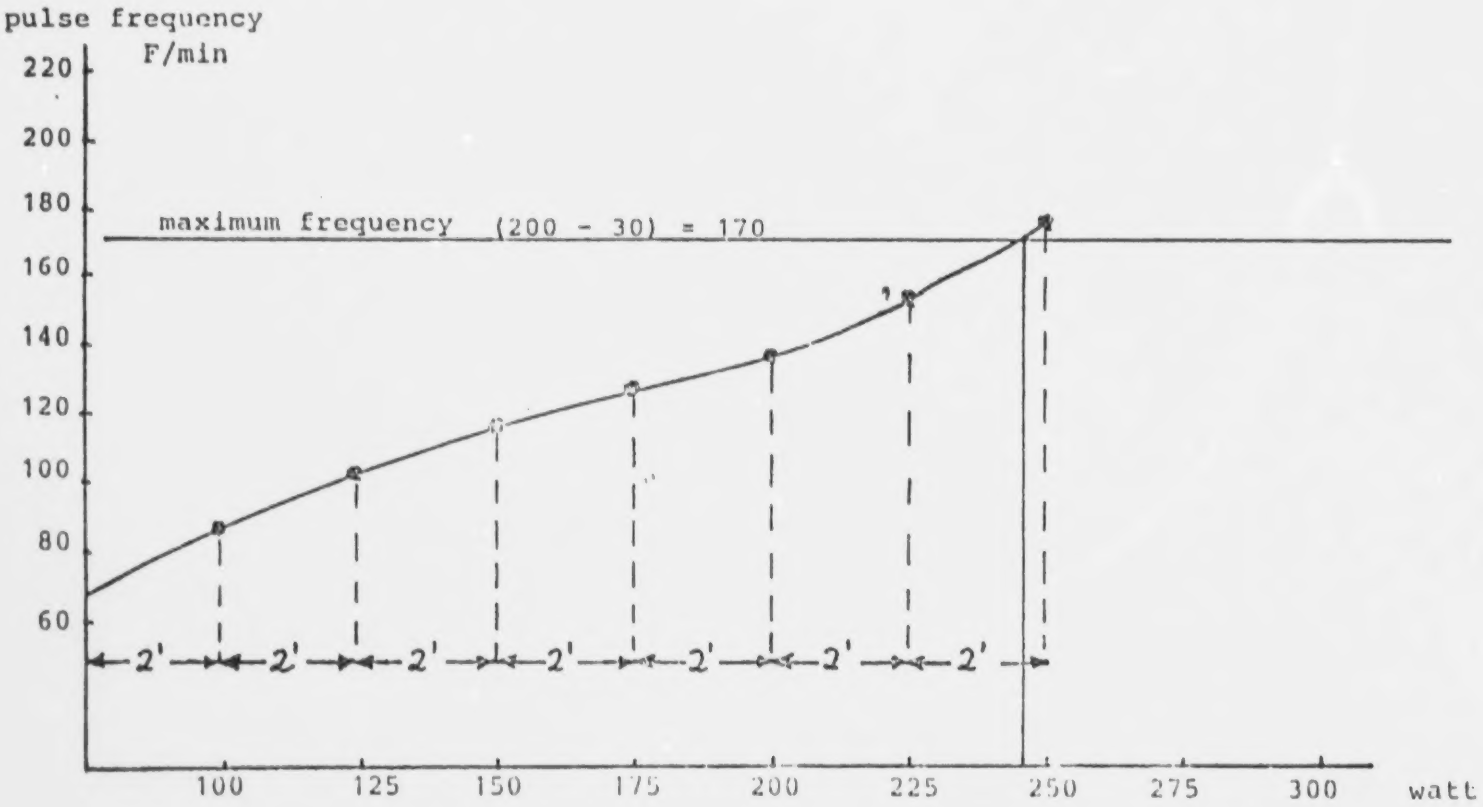
101 - 125	good	35	42%
> 125	very good	7	

Characteristic perseverance values for 300 members of mine rescue teams



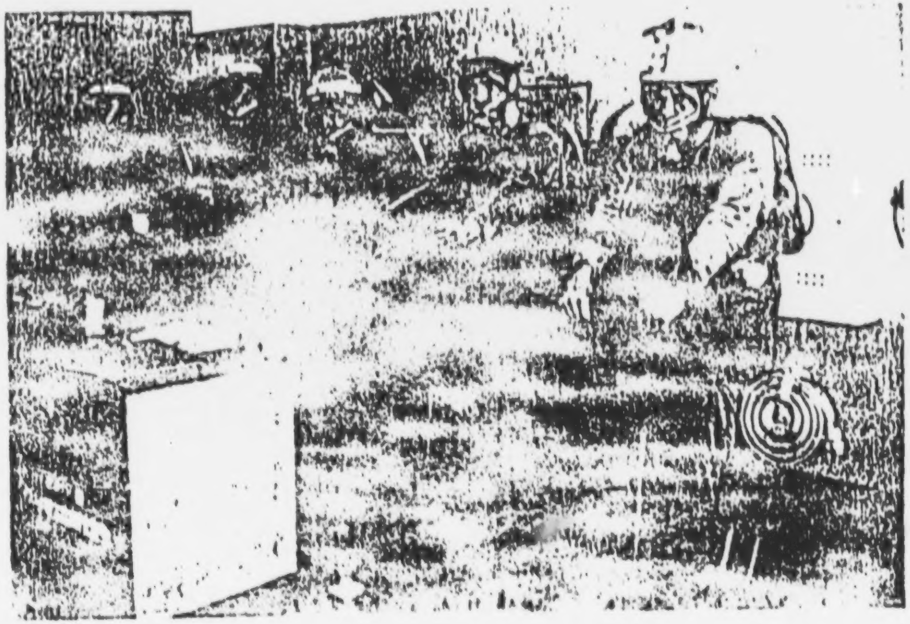
required: weight (kg) x 3 (watt/kg) minus 1 % per year of age above 30

in this case: 80 (kg) x 3 (watt/kg) = 240 watt

actual: 245 watt ≙ required value + 2 %

family name: MEIER christian name: Hans age: 30 years weight: 80 kg

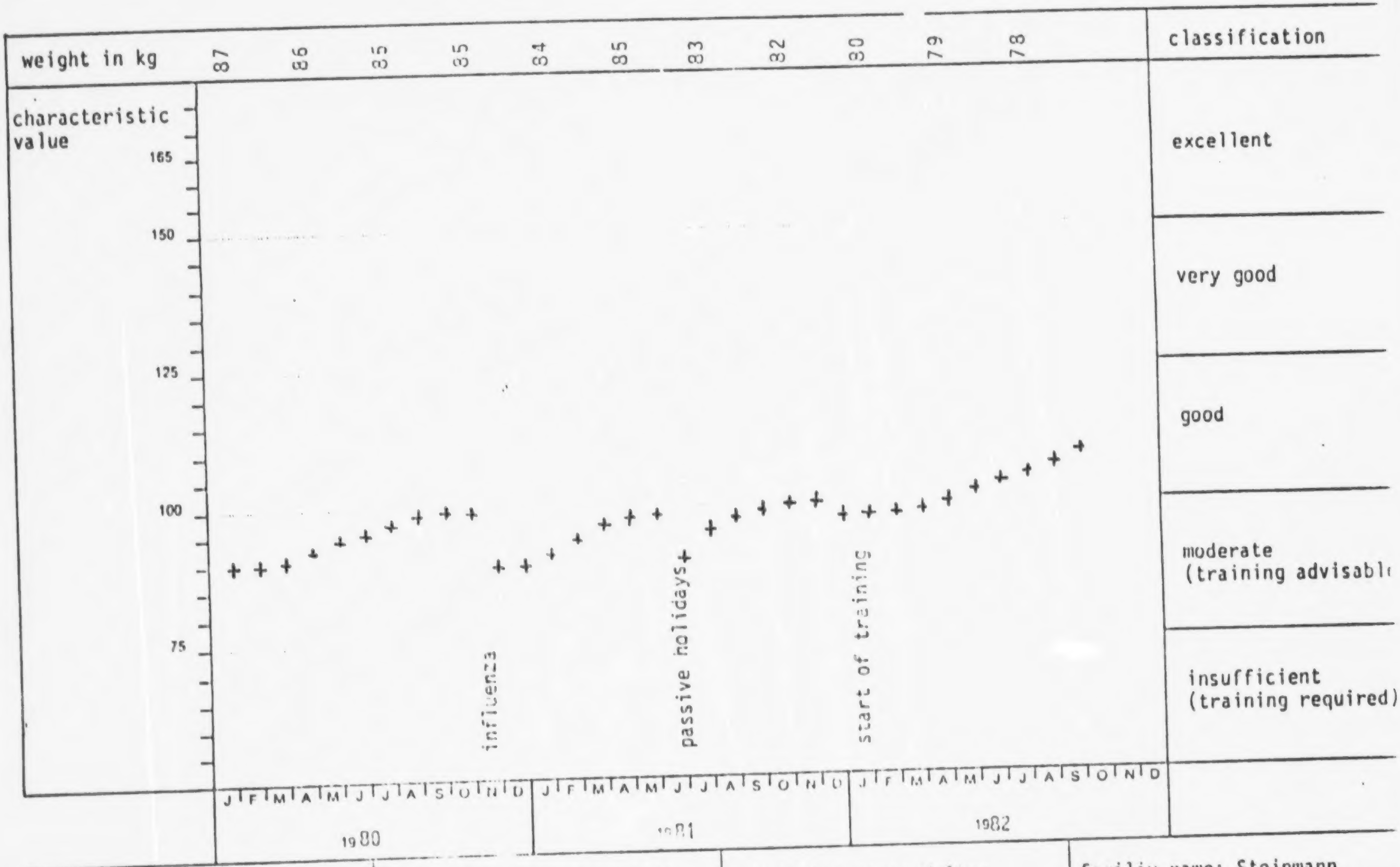
Abb. 24



1982

Mine rescue team on training bicycles

H GRWE



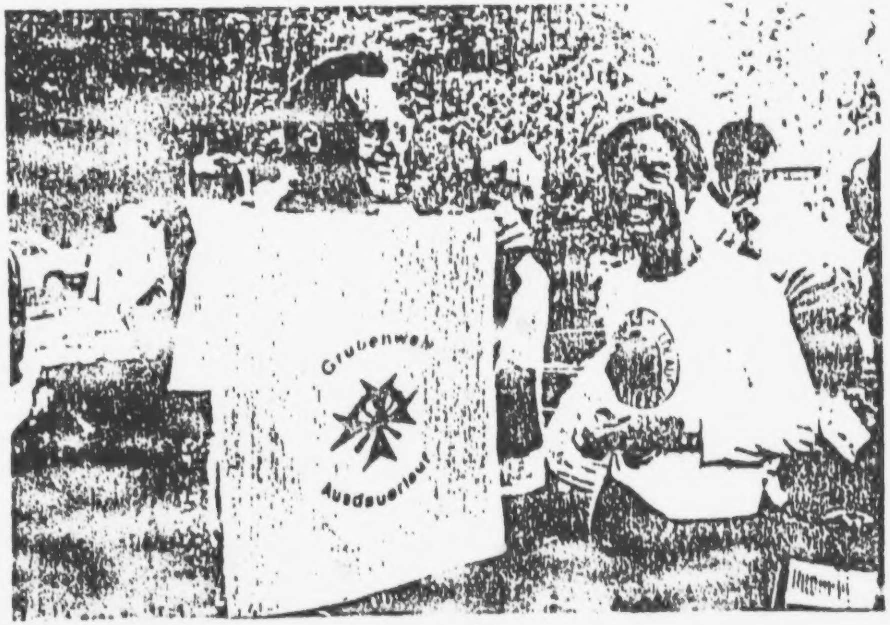
height: 1,81 m | date of birth: 27.06.1942 | christian name: Walter | familiy name: Steinmann

1982

Perseverance chart

H GI

Abb. 26

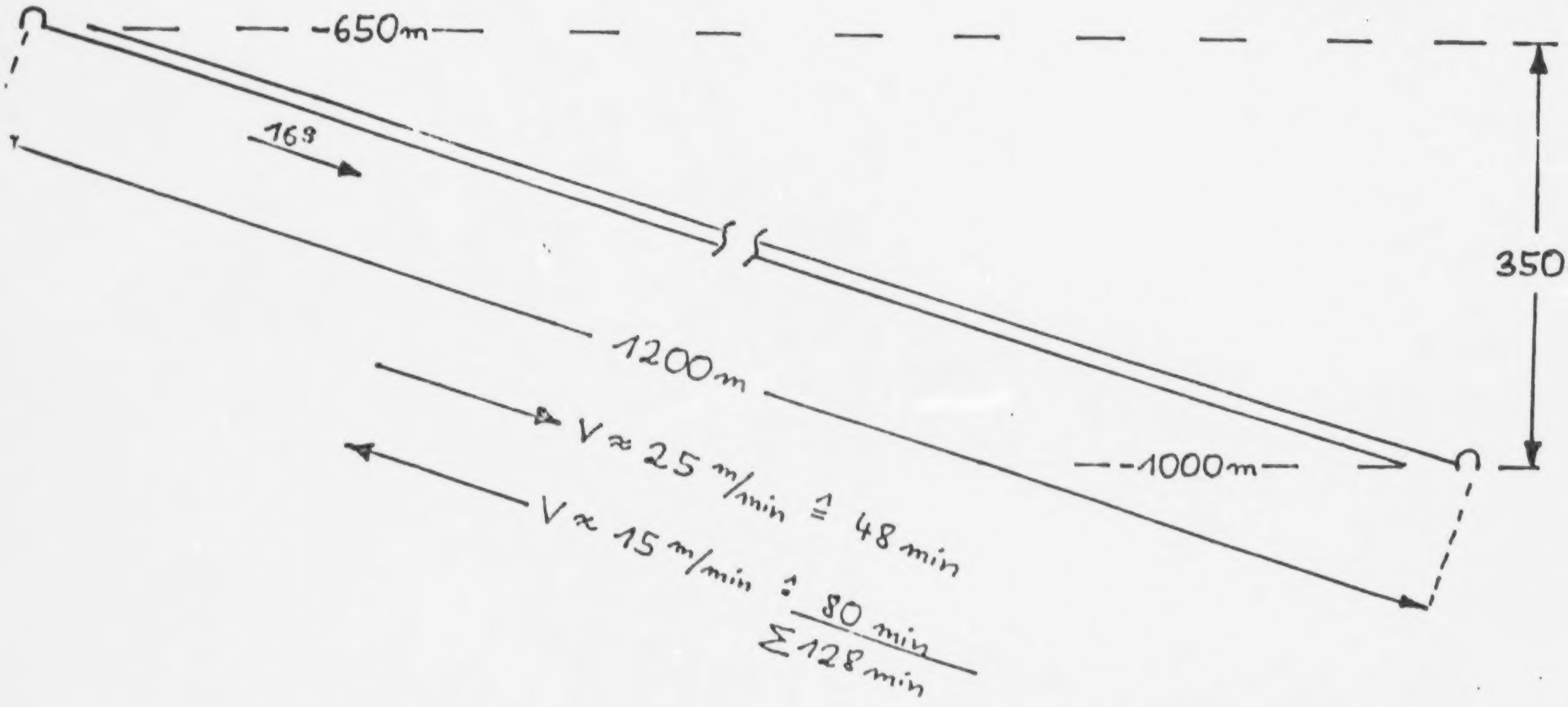

Grubenwehr
Ausdauerlauf

1982

Jogging for mine rescue members

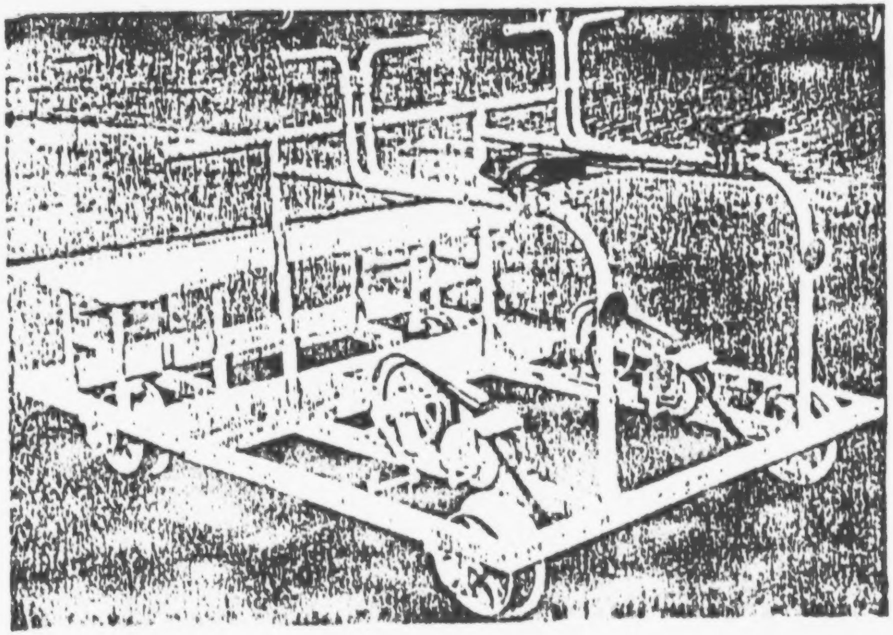
H GRWE

Abb. 27


-650m
16g
350m
1200m
-1000m
V ≈ 25 m/min ≙ 48 min
V ≈ 15 m/min ≙ 80 min
Σ 128 min

Travelling in drifts by mine rescue teams

Abb. 22



1982

Rail bicycle for mine rescue members

HGRWE

SECTION 4.5
POLAND

11-123E

POLISH EXPERIENCE IN POST EXPLOSION ACTION AND INVESTIGATION

Dr P.A. Krzystolik
Central Mining Institute
Safety in Mines Institute - Barbara Experimental Mine
Mikołów - Poland

Introduction

The Polish coalmining industry, with its yearly output oscillating around 200 million tons of hard coal, has to devote much attention to the problem of combating mine hazards. In all the three hard coal basins: the Upper Silesian, the Lower Silesian and the newly developed Lublin Coal Basin, typical mine hazards occur, with different intensity. Methane hazard is present in all basins. More than half of the hard coal output is won from gassy seams.

In the Upper Silesian Coal Basin great rock burst hazard as well as fire danger exist. The majority of the occurring coals are namely prone to self-combustion.

The gas outburst hazard is typical for the Lower Silesian Coal Basin.

In the new Lublin Coal Basin, where the first output tonnage is to be won still this year, there are great water hazards which largely contributed to the delay in mine constuction in this area.

Nearly in all mines highly explosive coal dust occurs.

In order to attain safe working conditions, in mines an adequate prophylaxis is carried out to control those hazards, and in case the hazard manifests itself in the form of an accident or disaster, activities are also organised for limiting the effects. Special services are trained for undertaking effective post-disaster actions, the chief aim of which it is to limit the accident results, above all to rescue men.

The present paper describes the main organizational outlines of those services and the way of conducting post-disaster actions.

The whole matter will be presented from the point of view of an research institute dealing with safety-in-mines problems.

Mine science plays an important part during conducting post--disaster actions. As it will be shown in more detail in the further part of the paper, scientific workers are - on the one hand - advisers putting their knowledge and experience at the disposal of the management of the action and - on the other hand - each post-disaster action is a source of invaluable information which inspires new investigations. In post-disaster actions also a severe verification of the scientific-research work takes place. Thus there are mutual benefits.

Owing to the author's specialization, the main stress will be laid on post-explosion actions. This will be illustrated by several selected examples of actions in which the author participated personally. The scope of the paper does not allow for an extension of the subject area. Should the participants show interest in other subjects connected with the Symposium, the author is ready to expand the subject area during the presentation of the paper at the Symposium.

2. Organization of rescue action in a mine

2.1. Definition of a rescue action

In accordance with the Polish Regulations such activities are regarded to be an rescue action that are connected with bringing help in case the lives or health of men in the mine are endangered and also in case the safety of the mine is endangered by:

- underground fire,
- gas explosion,
- coal-dust explosion,
- gas outburst or emission of gases into the mine workings rendering the atmosphere unfit for breathing,
- sudden inrush of water, slurry or loose rocks into the underground workings,
- rock burst or cave-in,
- break-down of technical equipment.

We distinguish difficult and easy actions.

An action is regarded to be difficult to carry out when:

- men are rescued,
- explosive concentrations of combustible gases occur,
- open fire is liquidated,
- the dry thermometer temperature at the rescue place is higher than 40°C,
- CO concentration in the mine air surpasses 20 ppm,
- CO_2 concentration in the mine air is 6% or more,
- rescue work is done at the liquidation of caved waste,
- rescue work is done in shafts, blind shafts and steep workings,
- work is done under water,
- rescue work is performed by the men wearing oxygen breathing apparatus.

2.2. Preparation of a mine for performing rescue action

According to Regulations all the personnel, material, technical, and organizational means, prepared at the mine, that are indispensable for a quick and efficient performance of the rescue action in case of a mine fire, explosion or caving-in, are comprised in the:

- colliery fire-fighting action plan,
- mine rescue and first-aid plan for the case of a mine fire, explosion of gas or coal dust, cave-in or inrush of water occurring.

The colliery fire-fighting action plan contains:

a/ data on (Pressure)
  - depression and capacity of the main fans,
  - arrangement of the fire-fighting equipment on the colliery surface and underground,
  - localization of the emergency stores of the mine itself and of the divisional coal board,
  - places where fires are likely to occur,

b/ schemes and ventilation-- and mine maps containing the layout of pipelines /for fire-fighting, stowing, compressed-air and degasification/, electrical equipment, communication and alarm devices and of the monitoring apparatus,

c/ directives concerning the sequence of men withdrawal from the hazardous zones,

d/ instructions on the organization of the fire-fighting action at the mine,

e/ instructions for the mine supervising personnel describing the mode of conduct from the moment of fire detection till receiving the first directives from the leader of the rescue action, f/ list of responsibilities of the members of the mine management and the mine supervising personnel in case of conducting fire-fighting actions,

g/ guidelines for the mine supervising personnel concerning the training of the underground crew how to behave in case of a mine fire,

h/ ready documentation /blank forms/ indispensable for entering all kinds of records during the rescue action.

The mine fire-fighting plan, together with the mine operation plan, is approved by the District Mining Authority /DMA/.

The mine rescue and first-aid plan contains:

a/ the mobilization plan of institutions and persons together with the plan of organizing the alarming system,

b/ specification of the responsibilities of individual persons at the mine during a rescue action,

c/ data on

- mine rescue organization at the mine,
- organization of the readiness of management, supervising personnel and rescue workers at the mine,
- organization of the mine gas-analysis laboratory,
- organization of the sanitary and medical service at the mine,

d/ plan of mutual back-up help of mines during actions,

e/ enumeration of specialized institutions /rendering e.g. emergency service in the field of transportable emergency hoists, drilling/that are foreseen to do rescue work in mines,

2.2. Preparation of a mine for performing rescue action

According to Regulations all the personnel, material, technical, and organizational means, prepared at the mine, that are indispensable for a quick and efficient performance of the rescue action in case of a mine fire, explosion or caving-in, are comprised in the:

- colliery fire-fighting action plan,
- mine rescue and first-aid plan for the case of a mine fire, explosion of gas or coal dust, cave-in or inrush of water occurring.

The colliery fire-fighting action plan contains:

a/ data on (Pressure)
  - depression and capacity of the main fans,
  - arrangement of the fire-fighting equipment on the colliery surface and underground,
  - localization of the emergency stores of the mine itself and of the divisional coal board,
  - places where fires are likely to occur,

b/ schemes and ventilation- and mine maps containing the layout of pipelines /for fire-fighting, stowing, compressed-air and degasification/, electrical equipment, communication and alarm devices and of the monitoring apparatus,

c/ directives concerning the sequence of men withdrawal from the hazardous zones,

d/ instructions on the organization of the fire-fighting action at the mine,

e/ instructions for the mine supervising personnel describing the mode of conduct from the moment of fire detection till receiving the first directives from the leader of the rescue action, f/ list of responsibilities of the members of the mine management and the mine supervising personnel in case of conducting fire-fighting actions,

g/ guidelines for the mine supervising personnel concerning the training of the underground crew how to behave in case of a mine fire,

h/ ready documentation /blank forms/ indispensable for entering all kinds of records during the rescue action.

The mine fire-fighting plan, together with the mine operation plan, is approved by the District Mining Authority /DMA/.

The mine rescue and first-aid plan contains:

a/ the mobilization plan of institutions and persons together with the plan of organizing the alarming system,

b/ specification of the responsibilities of individual persons at the mine during a rescue action,

c/ data on

- mine rescue organization at the mine,
- organization of the readiness of management, supervising personnel and rescue workers at the mine,
- organization of the mine gas-analysis laboratory,
- organization of the sanitary and medical service at the mine,

d/ plan of mutual back-up help of mines during actions,

e/ enumeration of specialized institutions /rendering e.g. emergency service in the field of transportable emergency hoists, drilling/that are foreseen to do rescue work in mines, f/ list of institutions foreseen to give additional assistance during large-scale rescue actions /militia, army, fire-brigade/,

g/ list of technical means present at the mine and the basic outfit of stores with hazard combating equipment,

h/ instructions and guidelines for conducting rescue actions,

i/ provisions regarding the actualization, storing and approval of the plan.

All members of the mine management and the supervising personnel are obliged to get acquainted with the mine rescue and first-aid plan. This concerns in particular persons responsible for performing and supervising definite operations during a rescue action.

2.3. Organization of the management of a rescue action

The Polish Mining Regulations determine the composition of the mine rescue action management. It is as follows:

- leader of the rescue action,
- leader of the rescue action underground,
- manager of the rescue basis.

The Regulations state also who can perform the above functions.

As time plays an important role in rescue actions, in the initial phase of the action these functions can be exerted by substitutional persons. Those can be: on the surface - members of the mine management or mine supervising personnel present at the mine and the mine dispatcher, and underground - each member of the mine management or mine supervising personnel who is nearest the hazardous region.

As a rule the mine manager is the leader of the rescue action. Because the supervision of the rescue action rests with the Mining Authorities, in case the action is conducted improperly, they can demand the change of the leader or take over the management of the action themselves.

The leader of the rescue action occupies a separate room which can be entered only by persons appointed by him. After taking over the leadership of the action and getting acquainted with the actual situation, the rescue action leader is obliged to:

- determine the hazard zone and the state of danger to which the mine crew in this zone is exposed,
- appoint the place for the rescue basis,
- continue the withdrawal of the endangered people,
- establish the ventilation conditions of the hazardous zone, above all to prevent the occurrence of hazards due to methane, noxious gases or oxygen deficiency,
- establish the way of removing the results of the hazard,
- establish the personnel roster of the management of the rescue action and appoint men from among the supervising personnel for carrying out rescue work at the individual shifts or to perform specific tasks,
- establish the number of the necessary rescue teams.

The leader of the rescue action is obliged to give a notification to his superiors and to the Mining Authorities once a shift.

The organizational scheme of the rescue action management is shown in Fig.1.

The organization system is divided into three divisions:

- the division which realizes the rescue work, i.e. the division which is responsible for performing rescue work underground according to the orders of the rescue action leader,
- the safeguarding division, i.e. the division which is responsible for the performance of basic work on the surface and auxiliary work underground,
- advisory division.

The role of the last division will be discussed in more detail owing to the person of the author who has taken part in rescue actions in the capacity of a member of the advisory staff and also because the Central Mining Institute, which he represents, ex officio belongs to the rescue action staff, as settled by pertinent provisions.

The staff is an advisory body of the rescue action leader.

The rescue action staff comprises representatives of the Ministry of Mining and Power, Mining Authorities, the Central Mine Rescue Station, specialists from the Central Mining Institute, research workers from mining high schools, the ventilation officer of the mine and possibly specialists from other mines. When there are great actions, e.g. during mine disasters, also a spokesman of the press is appointed. The advisory staff is headed by a representative of the ministry or a person appointed by the rescue action leader in agreement with representative of the ministry.

The room of the rescue action staff is in the neighbourhood of the rescue aotion leader. In order to provide the staff immediately with information on the course of action, a communication system is installed in that room making it possible to hear the conversations of the rescue action leader.

The basic tasks of the staff comprise the analysis of the situation underground, mutual settling of proposals concerning the way in which to perform the rescue work as well as ensuring the safety of that work. The proposals are given in writing to the rescue action leader by the chief of the advisory staff. The staff members cannot directly interfere with the activities of the action leader by suggesting their own advice. At the same time, by following the advice and recommendations of the staff, the action leader does not get rid of his responsibility since it results from the principle of one-man management.

In addition to the above mentioned activities, the representatives of the Safety-in-Mines Institute, the Barbara Experimental Mine - which is part of the Central Mining Institute - accomplish a number of other tasks. They:

- collect information which is later used during working out the official report on the causes of the accident /methane-, fire gases- or coal dust explosions or gas and rock outbursts/,
- give advice in the field of safe rescue action performance, in particular what regards protection against explosions,
- fix the proper moment for sending a team underground to do post-accident investigations,
- give specialistic assistance, with regard to gas analysis, calculation of explosibility factors and so on, to the men directing the action.

During the action an important part is played by the technical secretary to whose responsibilities it belongs:

- to enter, on behalf of the rescue action leader, all commands given and all notifications received into the "rescue action book",

- to complete documentation needed by the rescue action management,
- to complete maps indispensable for conducting the action,
- to set up collective gas analysis reports,
- to operate the communication equipment.

In rescue actions the fundamental role is played by the professional rescue service. Knowing the organization of that service one can get an insight into its responsibilities during rescue actions. Data on the organization of the mine rescue service in Poland are given in the next paragraph.

3. Mine rescue organization in Poland

The basic aims of mine rescue are:

- to maintain in constant readiness personnel, technical and organizational-technical means so as to be able to bring immediate help if the lives or the health of the mine crew are endangered or if serious danger threatens the safety of colliery operation,
- to popularize among the miners the principles of preventing and combating hazards occurring in underground mine workings and to equip the miners with proper means protecting them against the consequences of hazards,
- to do work at mines preventing or limiting the range of the hazard.

The above mentioned aims are realized by the Polish mine rescue service through a three-level organization system.

The organizational unit which directs the whole work of mine rescue on the terrain of Poland is the Central Mine Rescue Station /CMRS/ at Bytom. This Station supervises and controls mine rescue in all Polish mines /extracting coal and other useful minerals/.It is subject to the Ministry of Mining and Power.

The second organizational level constitute the District Mine Rescue Stations /DMRS/, which supervise the state of mine rescue at mines. In Poland there are 12 District Mine Rescue Stations.

During rescue actions the District Stations help not only mines of their own district. In such a station there is always an emergency rescue team ready for action. It consists of rescue men delegated in turn from each mine for the time of two weeks. The emergency team consists of 13 men: 11 rescue men, one mechani and a leader of rescue team.

In the District Mine Rescue Station equipment is stored for:

- detecting and controlling gases,
- respiratory protection of rescue men,
- telephone and radio communication for rescue purposes,
- giving medical help,
- extinguishing and isolating fires,
- performing rescue operations in case of cave-ins,
- removing water when underground workings are flooded,
- salvaging people by the help of the drilling technique.

At the District Mine Rescue Station at Bytom /not to confuse with the Central Mine Rescue Station/ a professional emergency team acts which consists of 56 rescue workers.

The training and routine exercises are done at the District Mine Rescue Stations and at the Central Mine Rescue Station.

The third mine rescue level is the rescue service of the mines. It consists of the mine rescue teams and the mine rescue stations. The minimum number of rescue workers in the rescue team is:

- 15 men in mines employing less than 500 persons underground per day,
- 30 men in mines employing more than 500 persons underground per day.

A rescue worker must fulfill certain conditions.

Each mine rescue station employs permanently some mechanics

Rescue teams have the following specializations in:

- working in shafts,
- driving rescue galleries,
- extinguishing fires in gassy mines,
- performing drilling operations,
- sealing stoppings and workings,
- performing work under water,
- constructing explosionproof bulkheads,
- rescue communication,
- hydraulic stowing,
- servicing energo-mechanical equipment,
- fire fighting,
- operating powered supports,
- removing consequences of gas outbursts.

At a Mine Rescue Station there should be the following number of breathing apparatus:

when the man power is:

500 men	- 12 apparatus,
501 - 1000 men	- 18 apparatus,
1001 - 3000 men	- 24 apparatus,
over 3000 men	- 30 apparatus.

In hard coal mining the following specialized emergency services are in existence:

- the transportable emergency hoist service for saving people in case of a shaft break-down,
- the drilling service for saving people through boreholes,
- the service for operating inert gas generators.

The transportable emergency hoists service is localized in enterprises possessing hoists suitable for this purpose. Those are hoists of the Hyse 1.25 type produced in Sweden and the Polish-made B1500A hoists which during shaft breakdown make it possible to get people out of shafts from depths of up to 1000 m.

The drilling service is provided by enterprises of the oil and gas extracting industries, by enterprises doing development work at mines and by the Methane Drainage Enterprise. The above mentioned enterprises dispose of equipment for drilling small diameter boreholes from the surface and from underground workings as well as of equipment for drilling large-diameter boreholes between levels, from the lower to the upper one /TURMAG drilling machines of the EW-1200 type/.

This service includes also equipment for saving people through boreholes, this equipment being stored in the Central Mine Rescue Station.

The service for operating inert gas generators is composed of transportation enterprises which give facilities for transporting the inert gas generators /Polish abbreviation GAG/ and other fire-fighting equipmment.

4. Activities of the Safety-in-Mines Institute, Barbara Experimental Mine in the field of post-disaster actions

Employees of the Barbara Experimental Mine have carried out post-disaster investigations after each mine explosion, independent of its scope, strength and consequences, for more than 50 years. Those investigations are aimed at reproducing the course of the explosion and the circumstances which have lead to the initiation of the explosion. In order to be able to fulfill its tasks in this field efficiently, the Barbara Experimental Mine is properly organized and equipped.

4.1. Organization

- Employees of the Experimental Mine who have great experience in the specific fields, are - by turns - on round-the-clock duties at home; the dispatcher of the Ministry of Mining and Power is notified about the duties every week. In case an accident or disaster takes place the persons on duty are obliged to notify the director of the Barbara Experimental Mine, or his deputy, who organizes the departure to the disaster.

- Also one of the drivers is on home duty, or the place where he stays is known
- a place has been fixed where the equipment needed for investigations is always kept.

4.2. Equipment

a/ For performing investigations at mines, at the Barbara Experimental Mine the following equipment is kept at a fixed place:

- water sampling tubes	/30 tubes/
- hermetically sealed containers for coal samples	/5 pieces/
- portable methanometers	/5 pieces/
- explosimeter	/1 piece/
- detector with indicating tubes	/1 piece/
- gauges for gas measurement in boreholes	/2 sets/
- box with instrumentation for taking dust and coke samples	
- anemometer	/2 pieces/
- velometer	/1 piece/
- electrical multimeter	/2 pieces/
- photographic camera with flash lamp and tripod	
- instrument for measuring stray currents, of the MEB-5 type.	

b/ For carrying out investigations on the samples, means, and devices taken from the disaster-stricken colliery, all the laboratories of the Barbara Experimental Mine are at disposal and in case of need they work round the clock.

Should need arise then highly experienced employees - above all the director of the Safety in Mines Institute, Barbara Experimental Mine - are on duty on the advisory staff at the accident mine.

4.3. Post-explosion investigations

The post-explosion investigations are carried out directly at the mine in which the accident has taken place and in the laboratories of the Barbara Experimental Mine.

Investigations done at the mine comprise:

- a thorough and detailed observation of all accessible workings affected by the explosion and of the neighbouring workings. Recorded are traces of the effect of high temperature as well as the direction in which the barrier and the outfit of the mine working have been thrown, due to the action of the shock wave, the displacement of supports and heavy equipment and so on,
- taking air samples and determining the contents of CH_4 and CO,
- taking coal samples in order to determine the content of gas in the coal,
- taking dust samples for determining the magnitude of dustiness their combustibles and moisture contents in the dust and the flame range,
- analysis of the state of the barriers and of the dustiness-combating equipment,
- ventilation measurements,
- description of the state of the electrical equipment and devic
- characteristic of the applied blasting accessories and kind of explosives used,
- taking pictures of the most characteristic post-disaster spots

Investigations done at the Barbara Experimental Mine, and in particular in its laboratories, comprise:

- analyses of the taken air samples,
- designation of the content of combustible gases in coal,
- designation of the chemical and physical quality of the dust samples,
- microscopic evaluation of coke content in dust samples,
- qualitative analysis of the used explosives,
- expertise of the blasting accessories and the electrical equipment,
- analysis of witness-hearing protocols and of photographs.

In some cases, which were especially difficult to be explain in the experimental galleries investigations simulating the gas and coal dust explosions were done.

4.4. Post-disaster investigation results

The Results of Post-Disaster Investigations contain the following chapters:

- Introduction, characterizing the place and the consequences of the disaster.
- Techno-mining and ventilation characteristic of the disaster section.
- Methane hazard investigations of the seam and the disaster-stricken workings.
- Coal-dust hazard investigations of the disaster-stricken workings.
- Determination of the explosion flame range.
- Characteristic of the state od electrical equipment in the workings after the explosion.
- Investigations of the blasting accessories.

- Additional investigations connected with the explosion, such as: photographic documentation, combustibility trials of e.g. cables, testing lamps, accumulators and so on.
- Expert evidence on the causes and circumstances of the explosic
- Conclusions.

5. Commission for investigating the causes and circumstances of the disaster

Still during conducting the post-disaster action, the Chairman of the Higher Mining Authority /HMA/ in consultation with the minister of the proper ministry, to which the disaster mine is subject, appoints the Commission mentioned in the title. The Commission is composed mainly of persons who are on the advisory staff of the post-disaster action. The Commission is chaired by one of the Vice-Chairman of the Higher Mining Authority, who also participated in the work of the advisory staff. The Commission is made up of the following persons:

- director of the mining department of the ministry,
- director of the District Mining Authority,
- director of the Central Mine Rescue Station,
- representative of the CMI - Safety in Mines Institute, Barbara Experimental Mine; usually the Director or his deputy,
- director of the superior authority of the disaster mine,
- the proper specialists /e.g. from universities/.

The members of the Commission get acquainted with the causes and circumstances of the disaster already during the post-disaster action. During its subsequent meetings the Commission prepares a report. This report is based chiefly on the inspection of the disaster place, the results of the catastrophic event, course and evaluation of the rescue action, investigations of the District Mining Authority under the supervision of the Higher Mining Authority, results of investigations done by the Barbara Experimental Mine and its experts, evidence and possibly additional specialistic expertises prepared by competent institutions or experts.

For example, the report made after a catastrophic explosion includes the following chapters:

a/ Introduction - contains information on the event and personal data of the victims

b/ General characteristic of the mine - contains data on the occurring hazards, applied preventive measures, previous events

c/ State of mining activities in the disaster area

d/ Description of the electro-mechanical equipment,

e/ Circumstances and course of explosion

f/ Course and evaluation of the rescue action

g/ Results of investigations conducted in connection with the explosion

h/ Causes of the explosion and the group accident,

i/ Conclusions of the Commission concerning the:
- mine in which the disaster took place,
- all hard coal mines,
- scientific-research centres,
- regulations, instructions and directives being valid at the present moment.

The Report is the basis for undertaking legal procedure against persons guilty of the disaster and is also the basis of various actions at different management levels aimed at evading similar disasters. Among other things it promotes the improvement of rescue actions.

6. Examples of rescue actions

Example 1.

During methane explosions hazards often overlap. Thus a methane explosion can be the cause of further hazards, such as coal-dust explosions, the formation of cave-ins and of fires. An example of a rescue action conducted due to the coming into being of such a complex of hazards is the action commenced at the "Silesia" hard coal mine on June 28, 1974 in result of a methane explosion combined with a coal-dust explosion /Fig.2/. At the time of the explosion, in the section the longwall No 69 was in operation and the longwall No 62 was being prepared. Already a longwall raise was ready for longwall No 62. Besides, two galleries were being driven, namely the return airway on level 0 and the intermediate road. The longwall No 69 had a leng of 108 m and a height of 2.5 m. It was supported by segmentary steel roof-bars and hydraulic props fed from a central pump.

Coal was worked by explosives, use being made of cutting machines.

During the transportation of material via the transport incline it was necessary to open the ventilation door of the air stopping installed in that incline. This caused ventilation disturbances in the region of the longwall No 69 /the amount of air sweeping the longwall decreased/ and the CH_4 concentratio rose. The concentration was measured by the recording methanometer of the Barbara ROW-3a type, which was installed in the return airway at longwall No 69.

An increase of CH_4 concentration was also recorded when after a longer standstill /lasting for some tens of hours/ the auxiliary fan was put into operation in the top heading I.

A growth of methane concentration was noted on June 26, 1974 from 9.30 to 10.29, when the concentration surpassed the measuring range /2.5% CH_4/ of the methanometer. This state lasted for 16 minutes up to 10.36, when the explosion took place. This state was signalled optically and acoustically in the dispatcher room, but the dispatcher on duty did not react to these signals.

The explosion affected the following workings: the return airway on level 0, longwall No 69, the top heading II, the raise of the being prepared longwall No 62 and the top heading I. The explosion was stopped by the operation of stone-dust barriers installed in the return airway on level 0, the top headings I and II in the neighbourhood of the transport incline. During the explosion there were 86 men in the hazardous area. Out of these 34 men found their death due to the effect of the explosion flame, high temperature and strong shock wave in workings having a length of 1 km and were killed by noxious components of post-explosion gases on the way of their flow. The explosion caused cave-ins at the crossings of the raise of the being prepared longwall No 62 in the distributing headings I and II, rock fall-down at the crossings of the longwall No 69 with the bottom road, destruction of air stoppings.

The dispatcher was informed about the occurrence of the explosion at about 10.45 by the section foreman who had been in the neighbourhood of the loading point of the section in the main heading on level I.

The crew withdrew from the explosion region using filter self-rescuers of the POG-type.

The first rescue teams were directed to:

- workings through which the post-explosion gases drew out, this is to the longwall top airway on level 0, to the ventilation drift on level 0 and further till shaft No V,
- workings, in which - on the basis of initial recognition - it was expected to find the greatest number of victims, namely to longwall No 69, top heading II and transport incline.

Among the 29 persons who were found by the rescue men in those workings there were no mortal victims. They were transported through the rescue basis to the first aid station of the mine and next to hospitals in the neighbourhood.

The greatest number of mortal victims were encountered in the top heading II and in the longwall No 69.

Thanks to the quick restoration of proper ventilation the region was cleared from noxious gases and physicians could enter the direct explosion area. Because the explosion had catastrophic results, and in particular caused a great number of victims, the action was conducted on a large scale. For example 30 normal ambulances and 2 reanimation ambulances were brought to the colliery. 42 physicians were ready to take care of the victims. At 14.15 the penetration of the workings in search of victims and work connected with giving medical help to the living victims was finished.

Then, successively, the corpses of the dead were brought to the surface and the recognition of the causes of the explosion was commenced. A commission was created to settle the causes of the explosion. The commission went down to the disaster area.

In addition to this two teams of specialists were organised for an exact inspection of the workings affected by the explosion During the inspection, at 0.30 on June 29th, in the bottom road of longwall No 69 an open fire was noticed. Immediately all persons, but the rescue men, were ordered to leave the hazardous area. Again rescue men from the emergency service of the District Mine Rescue Station were called into action and the fire-fighting action commenced.

The fire greatly complicated the situation underground. Till the fire was noticed it had not been possible to state the exact cause of the methane accumulation and explosion initiation, basing on details collected so far.

Because of great hazard threatening, the decision was taken to liquidate the fire by means of stoppings. Finally it was decided to provide explosion-proof gypsium bulk-heads and to neutralize the atmosphere behind the bulk-heads by inert gases.

For the first time in the history of the Polish coalmining the inert gas generator was used which produces an inert steam-gas mixture. The generator of the GIG-4 type was brought from the Soviet Union, together with a team of specialists. The fire-fi-ghting action was finally finished on July 6, 1974.

The reasons of the occurrence of the hazard.

Prior to commencing the fire-fighting action it had been possible to state that the accumulation of methane in the explosive range, in the air coming to long-wall No 69, was the result mainly of starting the auxiliary fan, which ventilated the top heading I. The methane explosion was probably initiated in the upper part of the longwall No 69. The initiation was brought about by frictional sparks produced by the picks of a cutting machine coming in contact with the stone substatum of the floor or by electrical equipment installed in the face.

The possibility was excluded that there was an interrelation between the fire and the selfheating which had been stated and was being removed before the explosion occurred. The appearing of open fire after the man-saving action was connected with the interruption of water infusion to the place where the self-heating occurred and the destruction of the air stoppings due to the explosion.

Example 2.

An other example of the origin of a complex hazard is the methane and coal-dust explosion in the Anna hard coal mine on Nov.7, 1974.

The explosion took place at 5.00 in the region of section G VII, in seam 630, in the Jedłowice part. It was initiated in workings affected by the rock burst which had taken place in the region earlier, namely at 3.24.

In the Jedłowice part, between the 500 m and the 700 m levels, in its western wing, seam 630 is counted to the II methane danger category. Coal is won there by the longwall system with caving with faces on level. On the day when the rock burst and the explosion occurred, in the G VII section only longwall No J-2 was in operation and for longwall No J-4 development work was going on. As there was a 12-14 m thick layer of sandy shale in the roof, the longwall was operated under special conditions. The longwall had a length of 160 m and its thickness varied from 1.5 to 2.6 m. The dip was 15-19°.

Course of the rock burst and rescue action

At 3.34 in the workings of section G VII a strong shock occurred, accompanied by air blast and crash. Those phenomena, which are characteristic for a rock burst, were felt in the whole section. The shock was recorded on the surface by seismographic stations, inter alia those in Racibórz, Dąbrowa Górnicza and Cracow.

The rock burst caused:

- a total or partial caving of the return air incline along a 320 m long section beneath the 500 m level, of five cross-cuts between the return air and the belt inclines, having a total length of 125 m and of the transport incline on a length of 265 m,
- damage of supports in the longwall raise J-4 /west/ from the side of the bottom road J-2 on a length of 24 m,
- crushing of non-mined pillars between the return air incline and the transport incline and the cross-cuts connecting both inclines,
- damage of the 6 kV and 500 V cables and of the communication system with the 500 m level, installed in the return air incline. In result of this the whole 500 m level was deprived of energy supply.

The rock burst and the damages resulting from cave-ins caused the stoppage of the fan ventilating the being driven incline J-6. Besides, the main way for transporting fresh air to section G VII was interrupted /due to the caving of the return air incline/.

In the rock burst area three men were injured /two seriously and one slightly/ by objects tipped over by the air blast and by the impact of rock fragments and support elements. The men were in the return air incline, the gallery J-2 and the gallery J-4. The remaining crew suffered no harm.

After men from other sections of the mine had notified the dispatcher about the rock burst, the undertaken rescue action was confined at first to the withdrawal of the whole crew from the hazardous area.

Course of explosion and continuation of the rescue action

At about 5.00 miners and supervising personnel, who were already at the underground railway stations on the 700 m level, as well as men engaged in removing debris from the faulted part of longwall J-5 in seam 630 and section G VI, and maintaining haulage equipment, again felt a strong shock and a violent air blast. In addition to this, workings in the neighbourhood of the underground railway stations became strongly dusted by stone dust originating from stone-dust barriers and dusted zones. The rescue action management was notified about those facts. At first they thought that these phenomena are connected with a secondary rock burst. Yet a detailed recognition which was made showed that this phenomenon was a methane/coal-dust explosion.

The explosion was no immediate threat to the people, because in the region where it occurred there were no men, as they managed to withdraw earlier. Also in the remaining regions there were no men since the working shift ended at 5.00.

The colliery rescue teams called to action and the emergency teams from the District Mine Rescue Station penetrated the accessible workings of the region affected by the explosion.

During the penetration it was stated that the range of the explosion had covered workings of section G VII in seam 630 damaging the supports, causing fall of ground and cave-ins and damaging mining equipment in longwall J-2, bottom road J-2, top road J-2, return air incline leading to the 500 m level, longwall raise J-4, longwall raise J-2 /east/, incline J-6, bottom road J-4 and in the cross-cut linking the main road in seam 630 with the bottom road J-4. The total length of the workings through which the explosion flame passed was about 1940 The explosion was stopped and confined in result of the effectiv operation of stone-dust barriers.

The removal of the consequences of the explosion took two weeks and was done by rescue teams and the crew of the colliery. During the removal of the effects of the cave-in,periodical methane accumulations were stated in the return air incline /up to 4.15%/ and in the bottom road J-4 /up to 6%/.

Basing on symptoms stated in the workings affected by the explosion it was assumed that the progress of the explosion was as follows:

- first a local methane explosion took place within the caved return air incline /the place of initiation was not determined exactly/,
- the local methane explosion initiated the coal-dust explosion, the dust being generated during the rock burst.

The accumulation of methane within the return air incline was due to intensified emission of CH_4 during the rock burst. This was the first case in the Polish coalmining industry that a rock burst was accompanied by increased CH_4 emission.

The following factors were assumed as the most probable ignition source:

- damage of the high-voltage cable during the short-circuit caused by the cave-in,
- transmission of signals via the damaged telephone cable in the time between the rock burst and the explosion. /The telephone network was not intrinsically safe/.

It also cannot be excluded that voltage was again connected to the power network installed in the rock burst region.

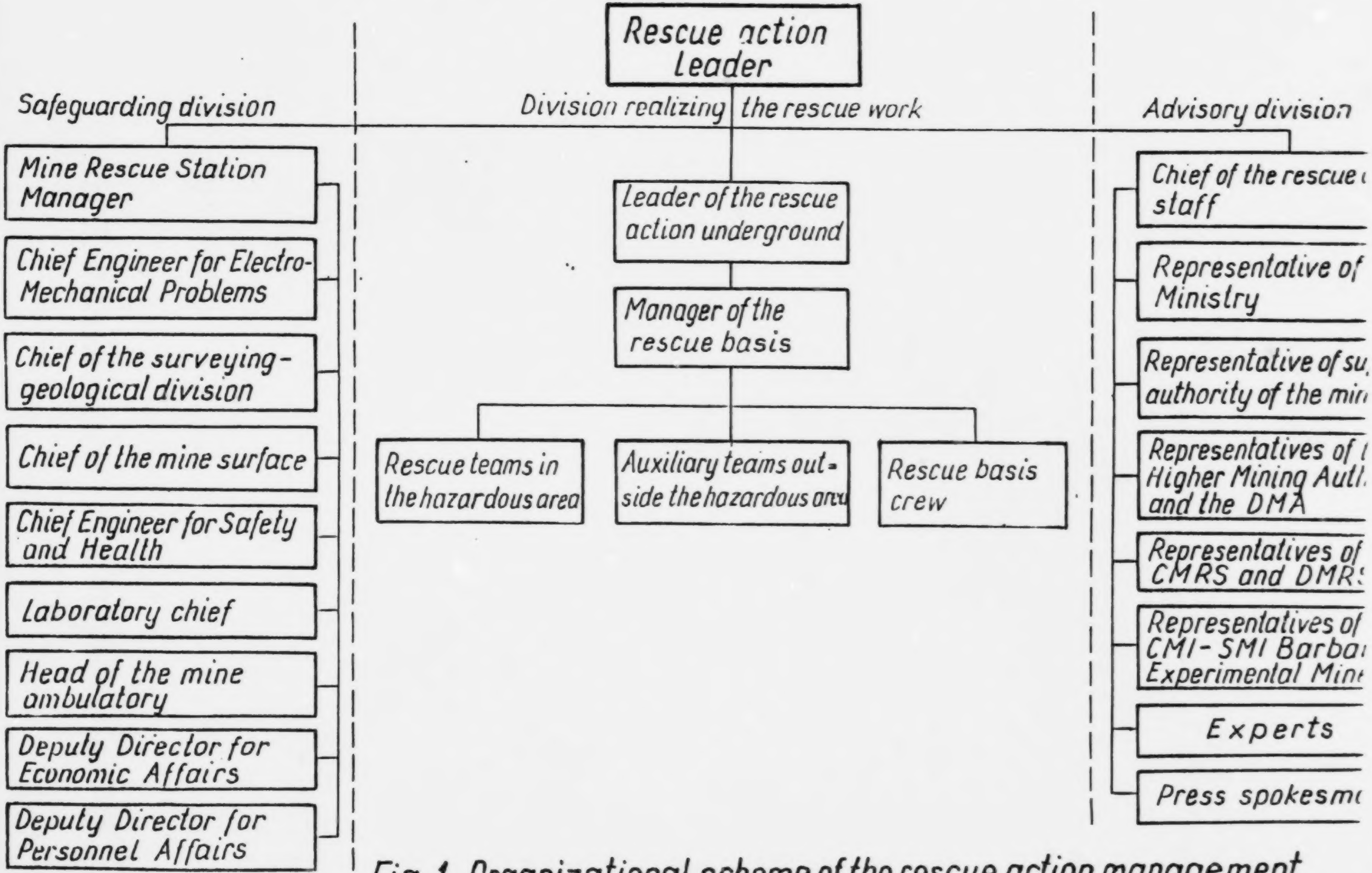

Rescue action Leader
Safeguarding division
Division realizing the rescue work
Advisory division
Mine Rescue Station Manager
Chief Engineer for Electro-Mechanical Problems
Chief of the surveying-geological division
Chief of the mine surface
Chief Engineer for Safety and Health
Laboratory chief
Head of the mine ambulatory
Deputy Director for Economic Affairs
Deputy Director for Personnel Affairs
Leader of the rescue action underground
Manager of the rescue basis
Rescue teams in the hazardous area
Auxiliary teams outside the hazardous ar
Rescue basis crew
Chief of the rescue staff
Representative of Ministry
Representative of su authority of the mi
Representatives of Higher Mining Aut and the DMA
Representatives of CMRS and DMR
Representatives of CMI-SMI Barba Experimental Min
Experts
Press spokesm

Fig. 1. Organizational scheme of the rescue action management

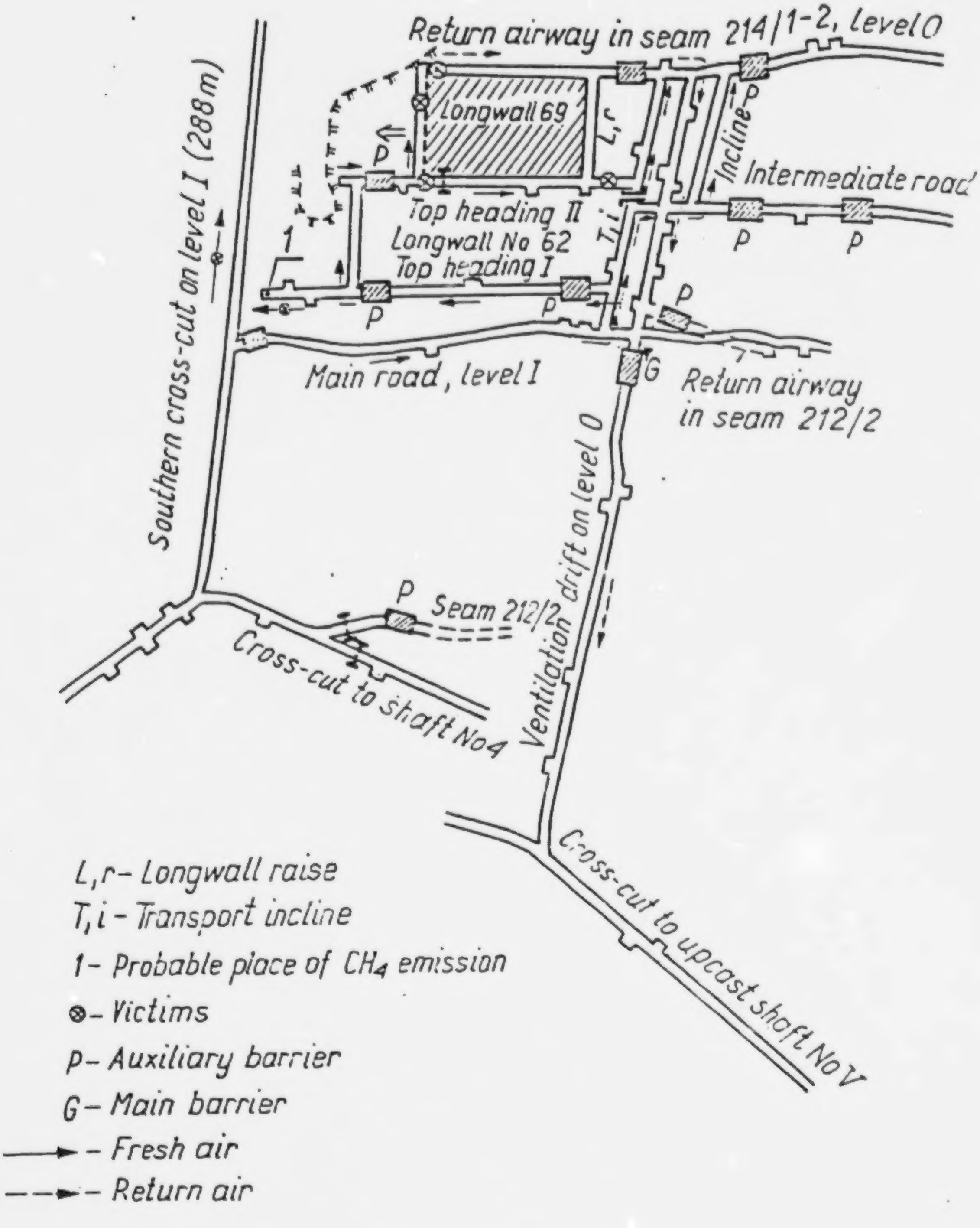

Return airway in seam 214/1-2, level 0
Longwall 69
L,r
Incline
Intermediate road
P
P
P
Top heading II
Longwall No 62
Top heading I
T,i
1
P
P
P
G
Main road, level I
Return airway in seam 212/2
Southern cross-cut on level I (288m)
Ventilation drift on level 0
P
Seam 212/2
Cross-cut to shaft No 4
Cross-cut to upcast shaft No V
L,r - Longwall raise
T,i - Transport incline
1 - Probable place of CH4 emission
⊗ - Victims
P - Auxiliary barrier
G - Main barrier
→ - Fresh air
- - → - Return air

Fig. 2. Disaster area in Silesia colliery (1974)

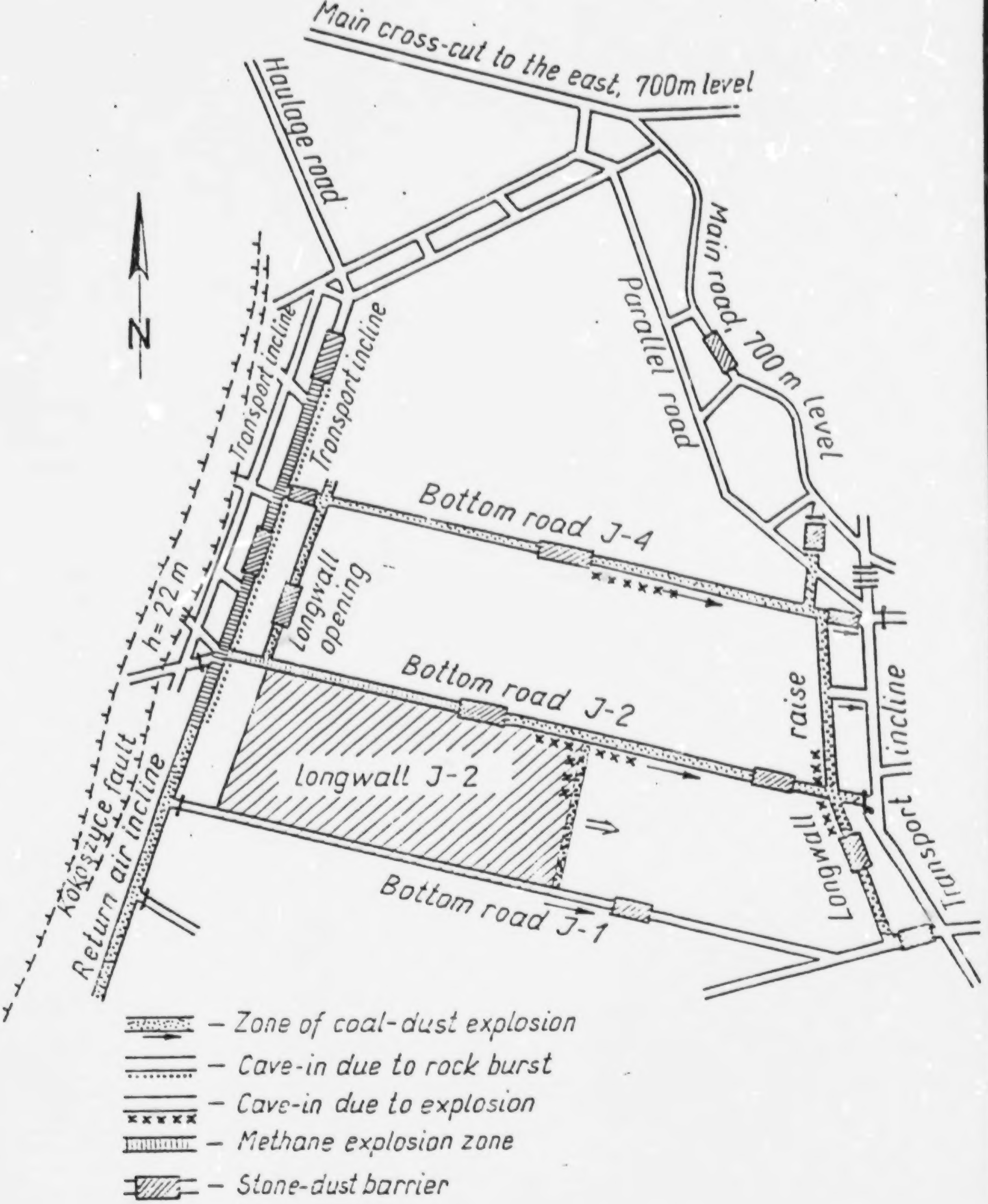

Main cross-cut to the east, 700m level
Haulage road
Main road, 700 m level
Parallel road
N
Transport incline
Transport incline
Bottom road J-4
Longwall opening
h=22 m
Bottom road J-2
raise
incline
Longwall J-2
Kokoszyce fault
Return air incline
Bottom road J-1
Longwall
Transport
– Zone of coal-dust explosion
– Cave-in due to rock burst
– Cave-in due to explosion
– Methane explosion zone
– Stone-dust barrier

Fig. 3. Disaster area in Anna colliery (1974)

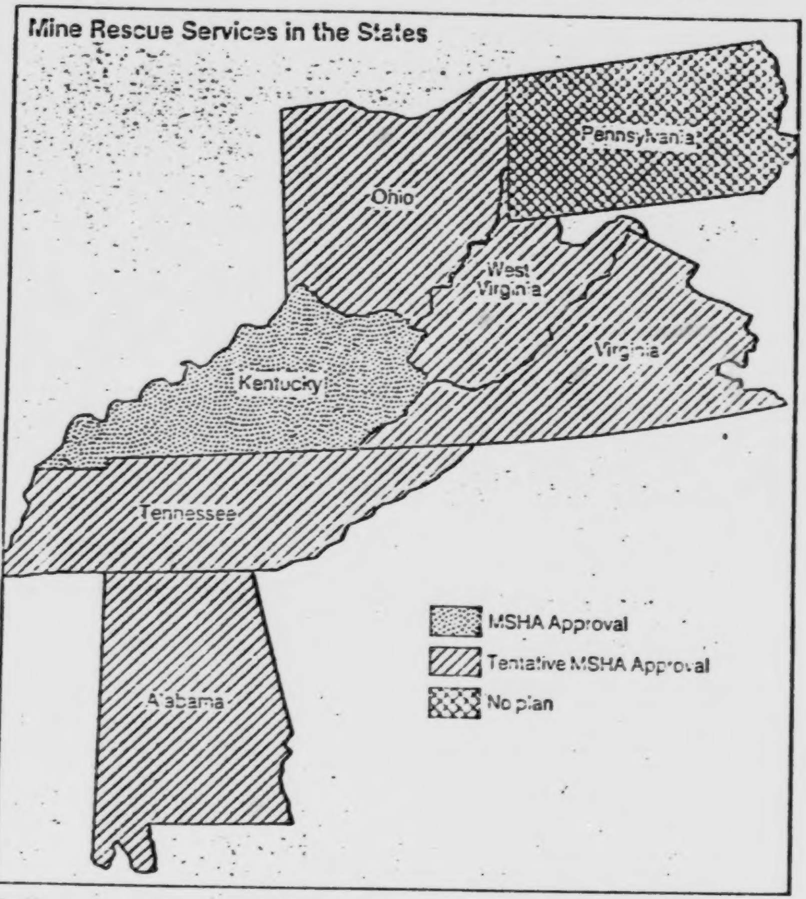
SECTION 4.6

KENTUCKY AND OTHER STATES MINE RESCUE SERVICE

MSHA Will Permit States to Provide Mine Rescue Services

The federal Mine Health and Safety Administration (MSHA) expects by the end of the year to permit eastern coalfield states to provide underground mine rescue team services to coal companies. A MSHA regulation that became effective last summer requires coal companies to have rescue teams available at each underground mine for emergency rescue and recovery work.

The regulation directs companies to form two rescue teams either independently or through cooperative agreement with others. States can enter into agreements with companies to provide the rescue team service if the appropriate state agency has authority to order rescue teams to emergency sites. Those states having a memorandum of understanding with MSHA can provide the service to the companies for compliance with the regulation.


Mine Rescue Services in the States

Kentucky leads the way

Kentucky is the only state thus far to enter a memorandum of understanding with MSHA. Kentucky Commissioner of Department of Mines and Minerals Willard Stanley said most coal companies in Kentucky are turning to his agency to meet the MSHA requirements.

Stanley said the state's providing the rescue team service is saving the Kentucky coal industry about $500,000 monthly. "If each company went out and set up it's own teams, it would be a tremendous cost," Stanley said. "The cost would be about $1,200 to $1,500 per month per company."

While Stanley says the state service saves operators $500,000 monthly, it does not cost the state government that much. He said the greatest cost involved in the state rescue team program was the initial outlay for equipment for the teams. A ready supply of labor for the teams is maintained through the state coal mine safety analysts program.

Kentucky was prepared to provide the rescue teams as the 1978 state legislature directed the Department of Mines and Minerals to establish rescue units. When the MSHA regulation became effective, Kentucky's rescue team program meshed with the federal requirements. The state's rescue teams are strategically located in Kentucky's eastern and western coalfields.

Stanley said, "MSHA is pleased and happy with the arrangement we have in Kentucky and they are trying to sell it to other states. We have had lots of calls from other states about our program."

Boon for small operators

Joe Lamonica, acting administrator for coal mine safety and health at MSHA, said he is not aware of any deficiencies in the Kentucky program. "It is working well for all parties concerned, especially the smaller operators.

"I think from the standpoint of the small operator and his expenses, for a small operator to field two teams would be impossible in some situations. The state program satisfies a definite need," he said. Lamonica said MSHA is currently working with Tennessee, Ohio, Virginia, West Virginia and Alabama to permit those states to offer rescue team service to operators.

"Everything is proceeding on schedule. If Kentucky is any guide, things will go smoothly," he said. Pennsylvania, however, apparently will not provide the service. Lamonica said, "I don't know if it is a closed issue, but it now appears there won't be one with Pennsylvania. I don't know that I fully understand the reasons for this; I believe finances had something to do with it." In lieu of the state providing the teams, Lamonica said an idea is in the wind in Pennsylvania for the formation of associations to provide the teams for member companies.

Lamonica said MSHA has not found too many serious problems in implementing and enforcing the regulation. "Mine rescue teams are not new to the industry and this is not a regulation we went out and blitzed the industry on. We knew the smaller operators may have some difficulty if they use a state program that does not have a memorandum of understanding. "We are proceeding with an approach to take that into consideration," he said. ■

SECTION 4.7
NEW SOUTH WALES

Appendix IV
Section 4.7

NEW SOUTH WALES MINES RESCUE SERVICE

---

by

M J MUIR
CHIEF INSPECTOR OF COAL MINES
NEW SOUTH WALES

J STRANG
SUPERINTENDENT
MINES RESCUE STATION, BELLAMBI
NEW SOUTH WALES

NEW SOUTH WALES
MINES RESCUE SERVICE

The State of New South Wales currently produces some sixty (60) million tonnes of black coal per annum from seventy (70) underground mines and twelve (12) open cut mines with further open cut and underground operations being developed.

Following the Bellbird Colliery disaster of the 1st September, 1923, the Mines Rescue Act came into force on the 31st December, 1925.

The Act provided for the establishment of a central rescue station in each of the four principle coal mining districts of the State, the manning of each station by a permanent corp under the direction of a superintendent, and the training of volunteers.

The sites selected were then central within the four mining districts namely:-

(i) Newcastle - at Cockle Creek
(ii) South Maitland - at Abermain
(iii) Southern - at Bellambi
(iv) Western - at Lithgow

Each station was to be under the direction of a Committee comprising four persons representative of the Colliery Proprietors within the district plus the District Workmans Safety representative (District Check Inspector). The proprietors representatives are elected by ballot at three yearly intervals.

Funding and administration was the task of the Committee, who were empowered to strike a yearly levy on the coal mines in the district to operate and maintain the station and equipment.

A station was built and equipped in each of the four district sites by the end of 1928. Station sites have, to date, remained unchanged, however, this will alter in the near future to meet the changing location of mining centres. The breathing apparatus then used was the Mark IV Proto. Presently three stations are equipped with Draeger BG 174 breathing apparatus and the other station with Aerolox and Draeger LOX 120 Liquid oxygen apparatus.

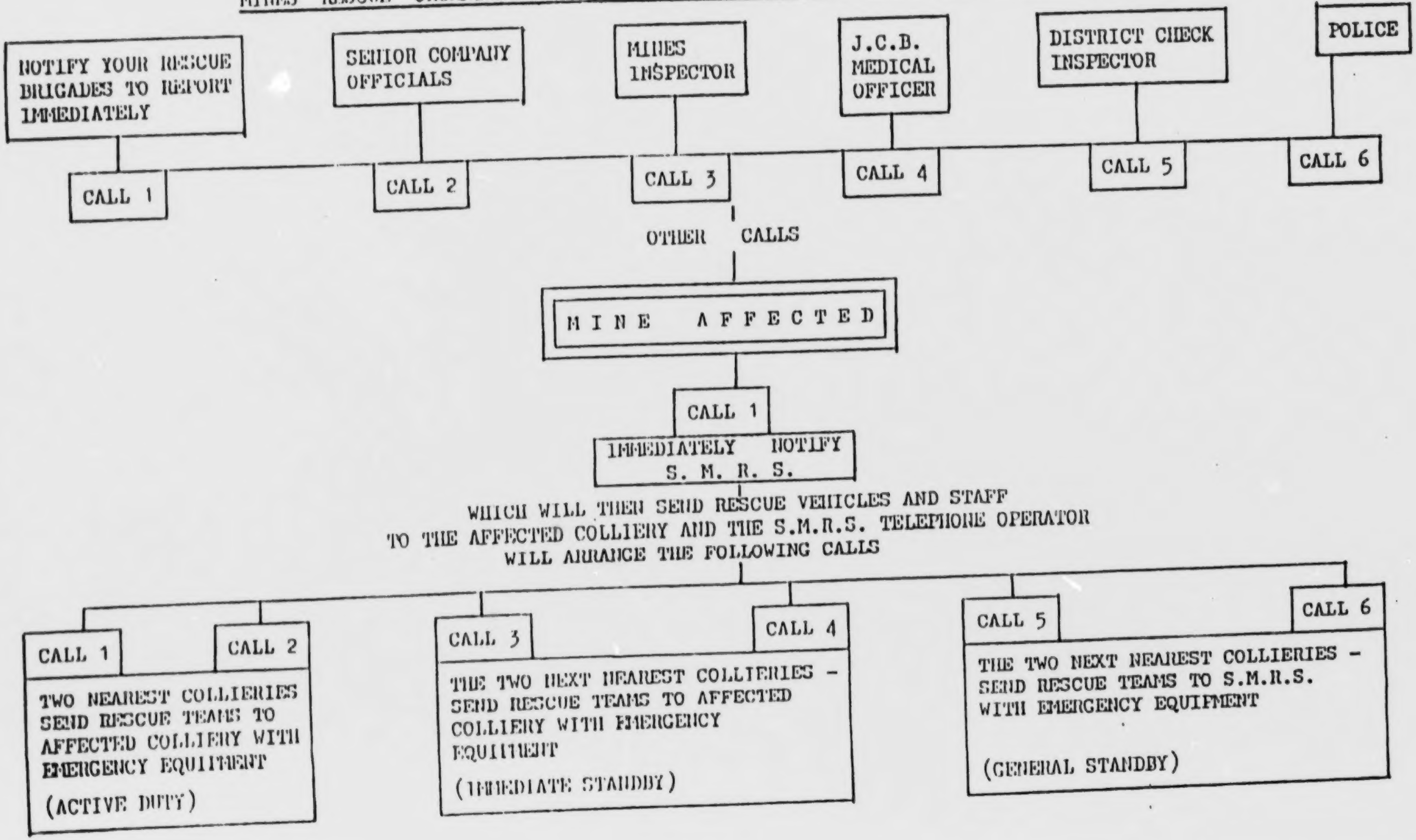
The Southern Mines Rescue Station uses the mutual assistance scheme in that sufficient apparatus is maintained at each colliery so that a team from the affected colliery, with backup from the nearest colliery can commence a rescue operation prior to the arrival of the rescue station equipment and personnel. (See chart following)

The other stations maintain sub stations in selected areas with sufficient equipment to allow local teams to commence an operation in their area pending the arrival of the rescue station equipment and personnel.

In recent times the problems of funding each of the stations became inequitable, particularly the Western District which is the smallest and was suffering a decline.

Legislation then provided for the formation of a Mines Rescue Board, a Central Board whose purpose is to determine the yearly levy on all Colliery Proprietors in the State and to recommend the disbursement of funds to the Rescue Stations. The rescue stations still operate under the control of district committees.

MINES RESCUE ORGANISATION - MUTUAL ASSISTANCE SCHEME - COASTAL COLLIERIES


NOTIFY YOUR RESCUE BRIGADES TO REPORT IMMEDIATELY
CALL 1
SENIOR COMPANY OFFICIALS
CALL 2
MINES INSPECTOR
CALL 3
J.C.B. MEDICAL OFFICER
CALL 4
DISTRICT CHECK INSPECTOR
CALL 5
POLICE
CALL 6
OTHER CALLS
MINE AFFECTED
CALL 1
IMMEDIATELY NOTIFY S. M. R. S.
CALL 1
CALL 2
CALL 3
CALL 4
CALL 5
CALL 6

WHICH WILL THEN SEND RESCUE VEHICLES AND STAFF TO THE AFFECTED COLLIERY AND THE S.M.R.S. TELEPHONE OPERATOR WILL ARRANGE THE FOLLOWING CALLS

TWO NEAREST COLLIERIES SEND RESCUE TEAMS TO AFFECTED COLLIERY WITH EMERGENCY EQUIPMENT

(ACTIVE DUTY)

THE TWO NEXT NEAREST COLLIERIES - SEND RESCUE TEAMS TO AFFECTED COLLIERY WITH EMERGENCY EQUIPMENT

(IMMEDIATE STANDBY)

THE TWO NEXT NEAREST COLLIERIES - SEND RESCUE TEAMS TO S.M.R.S. WITH EMERGENCY EQUIPMENT

(GENERAL STANDBY)

The Mines Rescue Board consists of:-

(a) The Chief Inspector of Coal Mines as Chairman;

(b) A person nominated by the Minister, representing the Electricity Commission;

(c) A person nominated by the Australian Coal and Shale Employees Federation (Miners Federation);

(d) A person nominated by the Colliery Staff Association;

(e) Two persons nominated by the New South Wales Combined Colliery Proprietors Association; and

(f) A person nominated jointly by BHP Pty Co Ltd and Australian Iron & Steel Ltd.

A member of a district committee cannot be a Board member.

The function of the Board has provided some unification in what was otherwise a number of independent systems.

Recently the Board has had constructed a new station at Lithgow (Western District) and work has commenced on the construction of a station and housing at Singleton with a view of transferring the Abermain Rescue Station activities (South Maitland District) to that location.

Planning is presently in progress for a station near Appin which will ultimately replace the present station at Bellambi (Southern District).

The present disposition of personnel, volunteer trained persons and equipment is as follows:-

Station	Volunteer Trained Persons	Rescue Station Personnel	BG174	Liquid Oxygen SCBA
			including Sub Station and/or Collieries	
South Maitland	89	9	43	-
Newcastle	245	9	-	62
Southern	497	12	163	-
Western	63	9	58	-

In addition there are 76 (BG58/1600) Compressed Air Units at the Newcastle District Collieries.

APPENDIX V
RESCUE WORKER SELECTION

SECTION 5.1

DEPARTMENT OF MINES, RESOURCES AND ENVIRONMENTAL MANAGEMENT

PROVINCE OF MANITOBA

Mineral Resources Division

Mining Engineering and Inspection Branch

MINE RESCUE APPLICANT - MEDICAL EXAMINATION

(To be completed by examining physician and retained by employer)

NAME: ______________________ AGE: ______ HEIGHT: ________ WEIGHT: __________

VISION: RIGHT EYE: LEFT EYE:

HEARING: RIGHT EAR: LEFT EAR:

NOSE: THROAT:

CHEST: Expanded: Deflated:

HEART Normal: After exercise:

After 2 mins. rest:

BLOOD PRESSURE:

ABDOMEN - SCARS: EXTREMITIES:

NERVOUS OR COMPOSED:

Summary of causes for medical rejection

a) 10% under or 20% overweight
b) Defective eyesight
c) 21 decibel loss in speech range, (500 H_z to 3000 H_z)
d) Schneider's Cardiovascular rating of ten indicates physical unfitness
e) Indication of respiratory diseases
f) Indication of cardiac disorder
h) Loss of more than two fingers or thumb on one hand.

The applicant is in my opinion of good physique and sound health and should be suitable for Mine Rescue training and capable of sustained work while wearing breathing apparatus.

DATE: 19 ____ Signed.......................................
(Examining Physician)

Address ....

The following sections to be sent to: Mining Engineering & Inspection Branch, Mineral Resources Division, Department of Mines, Resources & Environmental Management, Winnipeg, Ma

MINE RESCUE APPLICANT'S MEDICAL CONFIRMATION

(To be completed by examining physician)

NAME: ______________________

The applicant is in my opinion of good physique and sound health and should be suitable for Mine Rescue training and capable of sustained work while wearing breathing apparatus.

DATE: Signed.......................................
(Examining Physician)

Address.......................................

BRITISH COLUMBIA

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

MINE RESCUE TRAINING EXAMINATION

(To be used in determining the physical condition of men to wear oxygen breathing apparatus)

Name .... Age ....

Address .... Occupation ....

How long so employed ....

Employer ....

Date of last chest X-ray .... (Note - if not taken within the past 12 months, a new X-ray is required.)

Medical history

asthma, bronchitis, diabetes, epilepsy, heart ailment, hernia, pneumonia, rheumatic fever, spitting of blood, St. Vitus dance, tuberculosis, unsteadiness of gait, any chronic communicable disease.

Clinical examination

Pulse rate: at rest ....

after touching toes 30 times ....

Respiration rate: at rest ....

after above exercise ....

Condition of lungs and breathing passages ....

Chest X-ray .... Chest expansion ....

Heart action .... Condition of veins and arteries ....

Hearing ....

Vision ....

Nervous or composed temperament ....

Dermatitis ....

The candidate .... in condition to undergo mine rescue training.
(is or is not)

Date .... 19....

....
Physician

1969

QUEBEC

SELECTION OF RESCUE TEAM PERSONNEL

Selection of Rescuers

The rescuer must be a qualified miner who has volunteered to bring help and rescue with the eventual wearing of a breathing apparatus.

The successful selection of suitable men for work in mine rescue and recovery operations depends on the judgement of the mine management, the examining physician and the Mine Rescue Instructor.

Required Conditions

1 - Physical qualities

Before being given the approval to follow the training courses each candidate must undergo a medical examination (see medical report form at the end of this chapter).

At the beginning of the training, the candidate must present himself in good health and physically fit. The Mine Rescue Instructor will not commence training the candidate before receiving his medical report endorsed by the acting physician, and the manager of the mine concerned or his representative.

APPENDIX VI
MINE TEAM TRAINING

SECTION 6.3.1
BRITISH MINE RESCUE TRAINING SYLLABUS

APPENDIX VI
RESCUE TEAM TRAINING

SECTION 6.3.1

Great Britain Typical Mine Rescue Training Syllabus

REVISED INITIAL TRAINING SYLLABUS FOR RESCUE MEN

NOTES: 1. This syllabus is designed to occupy a minimum of 5 hours a day for 16 days, which may be continuous, or, say, one day a week for 16 weeks and each session shall consist of a lecture and a practical training. On the 15th and 16th days practical tests of an arduous nature shall be given, one on each apparatus. An oral test shall also be given on the 16th day.

2. Except on the first, 15th and 16th days the order in which subjects are dealt with in the talks can be varied if desired, in order, for example, to give more time to subjects of particular importance in the district in which the instruction is given.

3. When competent, Fresh Air Base Drill shall be carried out on all occasions when wearing Breathing Apparatus.

4. A minimum of four practices (two with each type of two-hour apparatus) shall be conducted in hot and humid conditions. The duration of the first practice in each type of apparatus should be in accordance with Lind's Chart. The second practices should be carried out in higher temperatures and the working period should be in accordance with Lind's Chart. Fifteen minutes before and after the working period the trainees should travel, coupled up, in the same environment. Suitable clothing, i.e. singlet and shorts, should be worn.

5. Sources of information for Talks: General Instruction Sheets should be used as a basis for the talks and a set given to each trainee. These sheets should be revised as and when necessary.

DAY	TALKS	PRACTICES
Day 1.	Organisation of the N.C.B. Mines Rescue Service with reference to local problems, Objects and scope of mine rescue work. Types of Stations. The Coal and Other Mines (Fire and Rescue) Regulation 1956, Part IV and First and Second Schedules. Colliery Emergency organisation. Emergency winders. Approved types of two-hour breathing apparatus.	Demonstration and explanation of Type T two-hour breathing apparatus followed by dismantling, re-assembly and testing. Walk at 3 m.p.h. (4.8 km/hour) wearing the apparatus with mouthpiece and noseclip in position but with the breathing tubes disconnected from the apparatus, for 30 minutes. Code of signals to be practised.
Day 2.	The atmosphere - composition - pressure and the barometer. Properties of oxygen, nitrogen and carbon dioxide. Physiology of respiration - volume of air inhaled in breathing - composition of exhaled air - effects of oxygen deficiency - asphyxia.	Dismantle Type A two-hour breathing apparatus while the function of each part is explained in detail. Re-assemble, immersion test and suction test. Wear apparatus coupled up (in fresh air) for 30 minutes, walking at 3 m.p.h. (4.8km/hour) and practise code of signals.

DAY	TALKS	PRACTICES
Day 3.	Liquid oxygen, its manufacture, standards of purity, properties and storage in bulk containers and Dewar vessels - transportation. Compressed oxygen, its manufacture, standards of purity and storage in cylinders. Pressure gauges, construction and use, precautions to be taken when using compressed oxygen and liquid oxygen. Air hose/line apparatus, principle types, uses and limitations.	Wear air hose/line apparatus in training gallery for at least 15 minutes. Practice dismantling Type I two-hour breathing apparatus without instructions - re-assemble - make immersion test and suction test. Wear Type I two-hour breathing apparatus coupled up for 45 minutes in training gallery in fresh air. Travel the roadways - pull weights - practice code of signals. Assist in dismantling, cleaning, testing and preparing apparatus for re-use.
Day 4.	Detailed description and purpose of each component of Type I two-hour breathing apparatus. Circulation diagram - principle of operation - care and handling - operational problems and how to deal with them.	Wear air hose/line apparatus in training gallery filled with light smoke for at least 15 minutes. Wear Type I two-hour breathing apparatus coupled up for 60 minutes in training gallery filled with light smoke. Travel the roadways - carry dummy on stretcher - travel through restricted roadway (2'0" high x 3'0" wide) for at least 20 feet. Assist in dismantling, cleaning, testing and preparing apparatus for re-use.
Day 5.	Firedamp - carbon monoxide, blackdamp, hydrogen and hydrogen sulphide. Their respective compositions and properties - methods of detecting their presence - dangerous concentrations. Effect of carbon monoxide on a small bird. Methods of collecting air samples for analysis.	Wear Type I two-hour breathing apparatus coupled up for 90 minutes in training gallery filled with medium smoke. Travel the roadways - transport rubble - carry dummy on stretcher - pull weights - travel through restricted roadway for 20 feet or more. Assist in dismantling, cleaning, testing and preparing apparatus for re-use.

DAY	TALKS	PRACTICES
Day 6.	Heat and Humidity - the hygrometer (construction and usage) - physical effects of hot and humid atmospheres on personnel - limitations on work in such atmospheres (Charts). Oxygen deficiency - effects on personnel - symptoms - treatment. Composition of mine atmosphere after fire or explosion - carbon monoxide poisoning in more detail - effects on personnel - symptoms - treatment. Resuscitation of the asphyxiated - principles - methods of artificial respiration. Reviving apparatus - relevant statutory regulations.	Hot and humid training, wearing Type I two-hour breathing apparatus - See Note 4. Carry dummy on stretcher - transport debris and build a loose pack - Practice methods of artificial respiration.
Day 7.	Detailed description and purpose of each component of Type 2 two-hour breathing apparatus. Circulation diagram - principle of operation - care and handling - operational problems and how to deal with them.	Wear Type I two-hour breathing apparatus coupled up for 120 minutes in the training gallery filled with dense smoke - practice recovery work from an advanced base, clearing falls, erecting supports, brattice screens and sandbag stopping. Practice methods of resuscitation and use of reviving apparatus at advanced base - practice use of portable telephones and writing messages.
Day 8.	Underground fires (other than spontaneous combustion) - causes - distinctive features - methods of dealing with them. Underground fire-fighting - importance of time factor - portable extinguishers, types and use.	Demonstration and explanation of type 2 two-hour breathing apparatus followed by dismantling, re-assemble and testing. Wear apparatus coupled up (in fresh air) for 45 minutes - travel with stretcher and reviver - pull weights. Assist in dismantling, cleaning, testing and preparing apparatus for re-use.
Day 9.	Spontaneous heatings and fires - how caused - detection - methods of dealing with them. Underground fire-fighting (contd.) - stone dust and sand - underground fire stations - water mains, hydrants and control valves - disposition of fire-fighting equipment - hoses and branches.	Wear Type 2 two-hour apparatus coupled up for 60 minutes in light smoke. Discharge portable extinguisher - practice running out fire hose from hydrant - make up equipment used and return to base - commence erection of sandbag stopping. Assist in dismantling, cleaning, testing and preparing apparatus for re-use.

DAY	TALKS	PRACTICES
Day 10	Underground fire-fighting (cont'd.) - detail and construction of different types of stoppings - air sampling pipes - access and ventilation tubes - steel doors for forming air locks - balancing of pressure at intake and return stoppings - simultaneous sealing.	Wear Type 2 two-hour breathing apparatus for 90 minutes in training gallery filled with medium smoke - extinguish small fire using (a) portable fire extinguishers and (b) fire hose - practice building a sandbag stopping. Assist in dismantling, cleaning, testing and preparing apparatus for re-use.
Day 11	Supplementary breathing apparatus - short duration, respirators and gas masks.	Wear short duration type supplementary breathing apparatus in the training gallery. Assist in dismantling, cleaning, testing and preparing short duration apparatus for re-use. Hot and humid training wearing type 2 two-hour breathing apparatus (see Note 4) Commence erection of a stopping with access and air sampling tubes.
Day 12	Mine plans - ventilation plans - rescue plans (Third Schedule) - fire-fighting plans - principles of construction - scales - conventional signs - full explanation of specimen plans. Relevant statutory regulations.	Wear Type 2 two-hour apparatus to 120 minutes in dense smoke in the training gallery. Complete erection of a stopping with access and air sampling tubes.
Day 13	Gas sampling - atmospheres in sealed areas - re-opening sealed areas, spark proof tools, etc. Escape type breathing apparatus.	Wear escape apparatus in the training gallery. Assist in dismantling, cleaning, testing and preparing apparatus for re-use. Second hot and humid training wearing Type 2 two-hour apparatus-(See Note 4.)
Day 14	Rescue operations during a fire or explosion at a colliery (Fire and Rescue Reg. 30/36) - Area Emergency Organisation - organisation of a rescue room and rescue teams - medical examinations - organisation at a Fresh Air Base - rescue communications underground, including portable telephones - telephone messages - Rules of conduct for rescue teams.	Second hot and humid training in Type 1 two-hour apparatus (See Note 4). Use of hygrometer and recording of results.

DAY	TALKS	PRACTICES
Day 15.	Lessons from the past - details of some explosions and fires at collieries in which rescue teams were employed - reports on formal investigations with special reference to plans and descriptions of rescue and recovery operations - lessons to be learned from these incidents - large Diameter Drill Rig Emergency Organisation.	Wear Type 1 two-hour apparatus in dense smoke for 120 minutes in gallery simulating some of the conditions likely to be encountered after an explosion. Recover dummy casualties and transport - investigate locus and cause of explosion - life line to be used during training period and hygrometer readings to be taken and recorded.
Day 16.	Oral Test.	Walking test at 4 m.p.h. (6.4 km/hour) wearing Type 2 two-hour apparatus or a practical test in the training gallery filled with dense smoke and equipped to represent a problem in rescue work after an explosion. The problem should include establishing an advanced base, removing falls and other obstructions, setting supports and brattice screens, recovering and treating casualties, taking hygrometer readings and observations on the conditions found.

SECTION 6.3.2
U.S. TRAINING MODULES

Mine Rescue Training

A Miner's Life
May Depend On It

West Virginia
University

Mining Extension
Service

MINE RESCUE TEAM TRAINING MATERIALS

Package No. 1

Initial Training Module

The modules include:

- -Instructors Manual
- -Introduction to Mine Rescue
- -Introduction to Self-Contained Breathing Apparatus
- -Draeger
- -Aerorlox
- -McCaa
- -Scott
- -Auxiliary Apparatus
- -Chemox

Plus

Advanced/Refresher Training Modules (Coal)

This package of 445 pages in eight modules covers:

- -Surface Organization
- -Mine Gases
- -Ventilation
- -Exploration
- -Fires, Firefighting and Explosions
- -Rescue of Survivors and Recovery of Bodies
- -Mine Recovery
- -Mine Rescue Activity Book

Plus

Advanced/Refresher Training Modules (Metal/Nonmetal)

This package contains the same topics as above relating to metal/ nonmetal

Price - $150.00

Package No. 2

Initial Training Modules

Price - $75.00

Package No. 3

Advanced Refresher Training Modules

Price - $75.00

Package No. 4

Initial Training Modules
Advanced Refresher Training Modules
Coal or Metal/Nonmetal

Price - $100.00

Also available..........

Slide-Tape Program *

To make your mine rescue training program complete, we have added an effective, informative slide-tape program, entitled "Introduction to Mine Rescue," to the training package.

This slide-tape program starts off your training with a 16 minute introductory level overview of federal mine regulations and the functions of a mine rescue team.

Price - $125.00

*order with any Module Package

Price - $45.00

Mail to: West Virginia University
Mining Extension Service
Mileground - Bicentennial House
Morgantown, WV 26506

Ordered by:

Name ____________ Title ____________

Address ____________

City ____________ State ______ Zip ______

Telephone (Area Code) ____________

Company ____________

Package No.	Quantity	Coal	M/NM	Price
1				
2				
3				
4				
Slide-Tape				
			Postage and Handling	
			Total	

Course Outline - Surface Organization

I. Introduction

II. Notification plan

III. Establishing a chain-of-command

IV. Making surface arrangements
  A. Suggested facilities and arrangements
    1. Command center
    2. Waiting area for teams
    3. Bench area for apparatus
    4. Security
    5. Information center
    6. Waiting area for families and friends
    7. Press room
    8. Food and sleeping quarters
    9. Laboratory
    10. Medical facilities
    11. Temporary morgue
  B. Suggested personnel and their duties
    1. Mine manager
    2. Mine superintendent
    3. Mine clerk
    4. Chief electrician
    5. Chief mechanic or mechanical foreman
    6. Outside foreman
      a. Checkman
    7. Safety director
    8. Chief engineer
    9. Supply clerk
    10. Lampman
    11. Mine foreman
    12. Other company personnel

Optional Resources:

Title 30 of the Code of Federal Regulations (30 CFR)

Course Outline - Mine Gases

- I. Introduction
    - A. Gas detection
    - B. Gas detector requirements
    - C. Portable gas detectors
    - D. Air sampling and chemical analysis
- II. Basic gas principles
    - A. Description
    - B. Diffusion of gases
        - 1. Atmospheric pressure and its effects on rate of diffusion
        - 2. Temperature and its effects on rate of diffusion
        - 3. Specific gravity or relative weight
    - C. Explosive range and flammability
    - D. Solubility
    - E. Color/odor/taste
    - F. Health hazards
        - 1. Toxic gases
        - 2. Asphyxiating gases
- III. Mine gases and their detection
    - A. Normal air
    - B. Oxygen
    - C. Nitrogen
    - D. Carbon dioxide
    - E. Carbon monoxide
    - F. Oxides of nitrogen
        - 1. Nitric oxide
        - 2. Nitrogen dioxide

G. Hydrogen

H. Hydrogen sulfide

I. Sulfur dioxide

J. Methane

K. Heavy hydrocarbons

  1. Ethane

  2. Propane

  3. Butane

L. Acetylene

M. Radon

IV. Smoke

V. Rock-strata gases

VI. The damps

Course Outline - Mine Ventilation

I. Introduction

II. Understanding ventilation
  - A. Airflow
  - B. Natural ventilation
  - C. Mechanical ventilation

III. Ventilation maps
  - A. Purpose
  - B. Map symbols

IV. Ventilation controls
  - A. Why used
  - B. Types of
    - 1. Bulkheads
      - a. Permanent
      - b. Temporary
    - 2. Check curtains or run-through checks
    - 3. Line brattice
    - 4. Auxiliary fans and tubing
    - 5. Overcasts and undercasts
    - 6. Mine doors
    - 7. Regulators

V. Assessing ventilation
  - A. Reporting condition of existing ventilation
  - B. Measuring airflow
    - 1. Anemometer
    - 2. Smoke tube

VI. Building ventilation controls
  - A. Temporary bulkheads
  - B. Permanent bulkheads
  - C. Air locks
  - D. Line brattice

Course Outline - Exploration

I. Introduction

II. Examination of mine openings

III. Barefaced exploration

IV. The fresh air base
  A. Establishing
  B. The fresh air base coordinator
  C. Advancing

V. Apparatus teams
  A. Team's role in exploration
  B. Equipment
    1. Team member's equipment
    2. Team equipment
      a. What the law requires
      b. Other

VI. Briefing

VII. Going underground
  A. Captain's responsibilities
  B. Getting under oxygen

VIII. Exploration procedures
  A. Team check
  B. Communications
    1. Team signals
    2. Communication with fresh air base
    3. Backup communication system

Course Outline - Mine Ventilation

I. Introduction

II. Understanding ventilation
  - A. Airflow
  - B. Natural ventilation
  - C. Mechanical ventilation

III. Ventilation maps
  - A. Purpose
  - B. Map symbols

IV. Ventilation controls
  - A. Why used
  - B. Types of
    1. Bulkheads
      - a. Permanent
      - b. Temporary
    2. Check curtains or run-through checks
    3. Line brattice
    4. Auxiliary fans and tubing
    5. Overcasts and undercasts
    6. Mine doors
    7. Regulators

V. Assessing ventilation
  - A. Reporting condition of existing ventilation
  - B. Measuring airflow
    1. Anemometer
    2. Smoke tube

VI. Building ventilation controls
  - A. Temporary bulkheads
  - B. Permanent bulkheads
  - C. Air locks
  - D. Line brattice

Course Outline - Exploration

I. Introduction

II. Examination of mine openings

III. Barefaced exploration

IV. The fresh air base
   - A. Establishing
   - B. The fresh air base coordinator
   - C. Advancing

V. Apparatus teams
   - A. Team's role in exploration
   - B. Equipment
      - 1. Team member's equipment
      - 2. Team equipment
         - a. What the law requires
         - b. Other

VI. Briefing

VII. Going underground
   - A. Captain's responsibilities
   - B. Getting under oxygen

VIII. Exploration procedures
   - A. Team check
   - B. Communications
      - 1. Team signals
      - 2. Communication with fresh air base
      - 3. Backup communication system

- C. Traveling procedures
    - 1. Advancing and tying in
    - 2. Order of travel
    - 3. Rate of travel
    - 4. Traveling in smoke
    - 5. Traveling through ventilation controls
    - 6. Traveling through water
    - 7. Crawling or climbing
    - 8. Marking route of travel
    - 9. Marking areas explored
- D. Ground testing
    - 1. Visual inspections
    - 2. Checking back and sides
- E. Testing for gases
- F. Progress reporting
- G. Mapping
- H. Return to the fresh air base

IX. Debriefing

Course Outline - Fires, Fire Fighting and Explosions

I. Introduction

II. Fires
  - A. Fire triangle
  - B. Classification of

III. Firefighting equipment
  - A. Dry chemical extinguishers
    - 1. General information
    - 2. How to use hand-held extinguishers
    - 3. Using hand-held extinguishers on an obstacle fire
    - 4. How to use wheeled extinguishers
  - B. Water
    - 1. Waterlines
    - 2. Fire cars
    - 3. Fire cars with low expansion foam
    - 4. Techniques of applying water to fires
  - C. High expansion foam
    - 1. Description
    - 2. Foam generators
      - a. Description
      - b. How to use

IV. Firefighting
  - A. Before going underground
  - B. Locating fires and assessing conditions
  - C. Direct firefighting
    - 1. General procedures
    - 2. Hazards of
      - a. Electrocution
      - b. Toxic and asphyxiating gases
      - c. Oxygen deficiency
      - d. Explosive gases
      - e. Heat, smoke, and steam

- D. Indirect firefighting
  - 1. Sealing underground
    - a. Planning
    - b. Temporary seals
      - (1) Types of
        - (a) Brattice cloth
        - (b) Concrete block
        - (c) Wood
      - (2) Considerations while building temporary seals
        - (a) Air sampling tubes
        - (b) Ventilation
        - (c) Explosions
        - (d) Isolation
    - c. Permanent seals
      - (1) Types of
      - (2) Considerations while building permanent seals
        - (a) Isolation
        - (b) Air sampling tubes
    - d. Taking air samples
  - 2. Foaming the fire area
  - 3. Using sandfill
  - 4. Flooding the mine

- V. Explosions
  - A. Causes and effects
  - B. Before going underground
  - C. Exploration: Indications of explosion and assessment of conditions

Course Outline - Rescue of Survivors and Recovery of Bodies

I. Introduction

II. Rescuing survivors
  - A. Locating survivors
  - B. Entering refuge chambers or barricades
  - C. Injured survivors
    - 1. Triage system
    - 2. Psychological factors
  - D. Bringing survivors out
    - 1. Miners found in open areas
    - 2. Miners found in refuge chambers or behind barricades

III. Body recovery
  - A. Locating the dead and marking the area
  - B. Condition of bodies
  - C. Handling the bodies
  - D. Surviving families

Course Outline - Mine Recovery

I. Introduction

II. Assessing conditions

III. Reestablishing ventilation after a fire or explosion
  A. Unsealing a fire area
    1. When to unseal
    2. Preconditions for opening a sealed fire area
    3. Preparations for opening a sealed fire area
    4. Methods of unsealing
      a. Recovery by progressive ventilation
      b. Recovery by direct ventilation
  B. Reventilation after an explosion
    1. Considerations
    2. Using progressive ventilation

IV. Clearing and rehabilitating the affected area
  A. Ground control
  B. Pumping water
  C. Clearing roadways and track
  D. Loading out falls and hot debris
  E. Restoring power
  F. Reestablishing the communication system

MSHA 2004

Draeger BG174-A
Self-Contained Breathing Apparatus

MSHA Approved Mine Rescue - Training Module

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

West Virginia
University

Mining
Extension
Service

Mine Rescue Team
Series - Initial

Course Outline

- I. The Draeger BG 174-A
  - A. Description
  - B. Where you wear it
  - C. How it works
- II. Parts of the Draeger BG 174-A
  - A. Cover
  - B. Wearing harness
  - C. Oxygen cylinder
  - D. Oxygen control group
    - 1. Pressure reducer
    - 2. Dosage metering orifice
    - 3. Preflush unit
    - 4. Pressure gauge shutoff valve
    - 5. Bypass valve
  - E. Pressure gauges
    - 1. Chest gauge
    - 2. Cylinder gauge
  - F. Warning whistle (BG 174-A only)
  - G. Breathing bag
  - H. Regenerative canister
    - 1. Refillable, training
    - 2. Factory-packed, rescue
  - I. Lung demand assembly
    - 1. Diaphragm
    - 2. Pressure relief valve
    - 3. Lung demand valve
    - 4. Inhalation and exhalation valves
    - 5. Acoustic reed warning device (BG 174)
    - 6. Dosage metering device (BG 174)
  - J. Facepiece
    - 1. Panorama Nova
    - 2. Scottoramic and Panorama ZS (BG 174)
  - K. Breathing hoses
    - 1. For Panorama Nova facepiece
    - 2. For Scottoramic and Panorama ZS facepieces (BG 174)

III. Putting on the apparatus
   - A. Put on the unit with hoses attached
   - B. Attach hoses to facepiece
   - C. Turn on apparatus (open cylinder valve)
   - D. Put on the facepiece
   - E. Check for airtightness
   - F. Check pressure

IV. Wearing the apparatus
   - A. Manual functions
   - B. Limitations
      - 1. Weight and size of apparatus
      - 2. Time limit, work rate, and breathing rate
      - 3. Temperature range
      - 4. Others
   - C. Suggested wearing schedule

V. Taking off the apparatus
   - A. Remove facepiece
   - B. Release springhook from saliva trap holding device
   - C. Disconnect breathing hoses from apparatus
   - D. Close cylinder valve
   - E. Take off unit

VI. Bench duties
   - A. Cleaning and disinfecting the apparatus
      - 1. Removing the exposed parts
      - 2. Washing, rinsing, and drying
      - 3. Reassembling the apparatus
   - B. Storing the apparatus
   - C. Oxygen cylinders
      - 1. Description
      - 2. Hydrostatic testing
      - 3. Pressure service rating
      - 4. Handling and storing
      - 5. Filling

D. Testing the Draeger
  1. Recordkeeping
    a. Testing records
    b. Maintenance records
    c. Tagging
  2. The Universal Rz25 Tester
    a. Description
    b. Testing the tester
  3. Testing procedure
    a. Visual inspection
    b. Insert oxygen cylinder
    c. Insert regenerative canister
    d. Facepiece and breathing hoses examination
    e. Exhalation valve test
    f. Inhalation valve test
    g. Relief valve test
    h. Positive pressure leak test
    i. Negative pressure leak test
    j. Preflush/pressure gauge equalization test
    k. Lung demand valve/breathing bag volume test
    l. Bypass/constant dosage test
    m. Whistle activation test
    n. Whistle duration/pressure gauge shutoff test
    o. High- and medium-pressure leak test

E. Troubleshooting
  1. Exhalation valve test
  2. Inhalation valve test
  3. Relief valve test
  4. Positive pressure leak test
  5. Negative pressure leak test
  6. Preflush test
  7. Pressure gauge equalization test
  8. Lung demand valve test

9. Breathing bag volume test
10. Bypass test
11. Constant dosage test
12. Whistle activation test
13. Whistle duration/pressure gauge shutoff test
14. High- and medium-pressure leak test

F. Periodic maintenance

Main Training Areas Covered in Each Activity

Activity	Level	Apparatus	Surface Organization	Mine Gases	Mine Ventilation	Exploration	Fires, Firefighting, and Explosions	Rescue of Survivors, Recovery of Bodies	Mine Recovery
#1 Using Gas Detectors	1			✓					
#2 Assessing Gas Conditions	1			✓					
#3 Interpreting a Ventilation Map	1				✓				
#4 Using an Anemometer Underground	2	✓			✓				
#5 Building Temporary Bulkheads	2	✓			✓				
#6 Practicing Exploration Duties	1	✓		✓		✓			
#7 Carrying Out an Exploration Assignment	2	✓		✓		✓			

Main Areas Covered in Each Activity (Con't)

Activity	Level	Apparatus	Surface Organization	Mine Gases	Mine Ventilation	Exploration	Fires, Firefighting and Explosions	Rescue of Survivors, Recovery of Bodies	Mine Recovery
#8 Using Hand-Held Dry Chemical Extinguishers	1						✓		
#9 Firefighting Practice Session	2	✓					✓		
#10 Assessing Fire and Post-Explosion Situations	1		✓	✓	✓	✓	✓		
#11 Using a Foam Generator Underground	2	✓					✓		
#12 Using an Air Lock to Rescue a Survivor	2	✓			✓			✓	
#13 Determining Hazards and Procedures in a Recovery Operation	1			✓	✓	✓			✓
#14 Mock Disaster	2	✓	✓	✓	✓	Depending on the problem, one or more of these topics will be included.			

SECTION 7.2
RESPIRATORY EQUIPMENT

OPERATING INSTRUCTIONS
(Fitting Instructions for Users)

Filter Self Rescuer 910

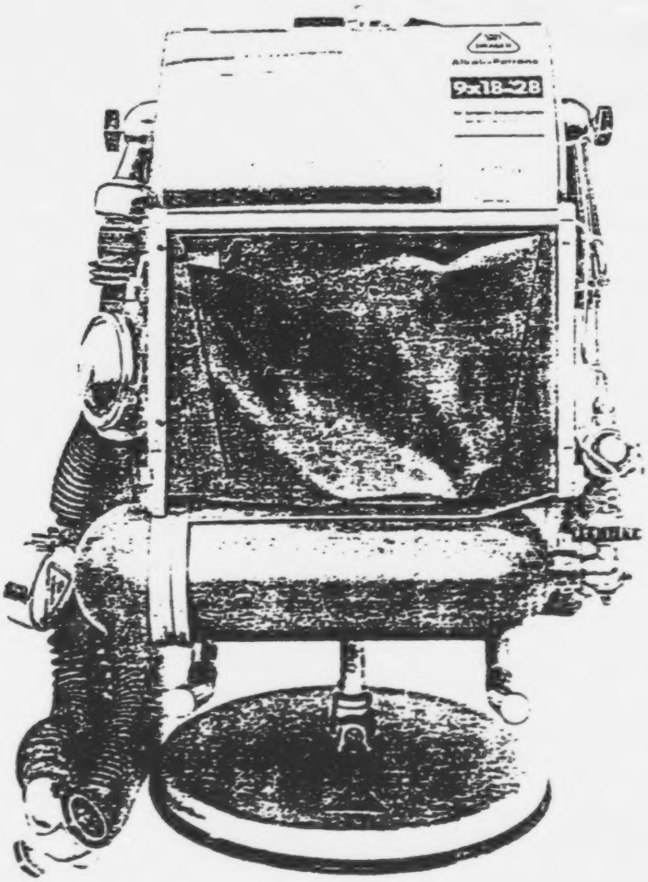
1
Description

1.1
General

The oxygen set BG 174 is a back-worn breathing apparatus which enables the miner or fireman to work in atmospheres deficient in oxygen or containing respiratory poisons. It renders the wearer completely independent of the surrounding atmosphere and enables him to save lives and equipment, even when performing extremely heavy physical work.

Although it is particularly light, the set is

Fig. 1 Oxygen breathing apparatus BG 174, open



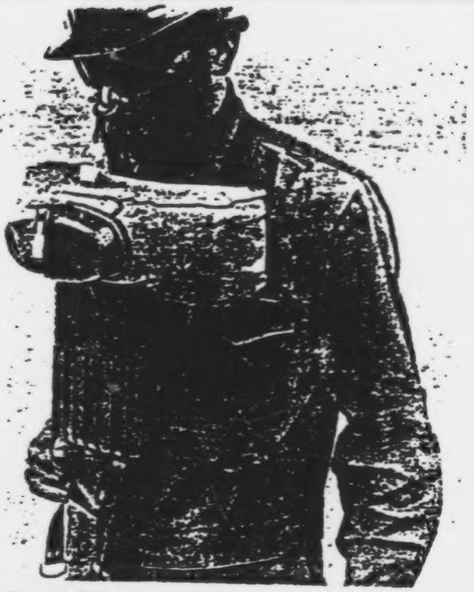


Fig. 3 Oxy-SR® 30

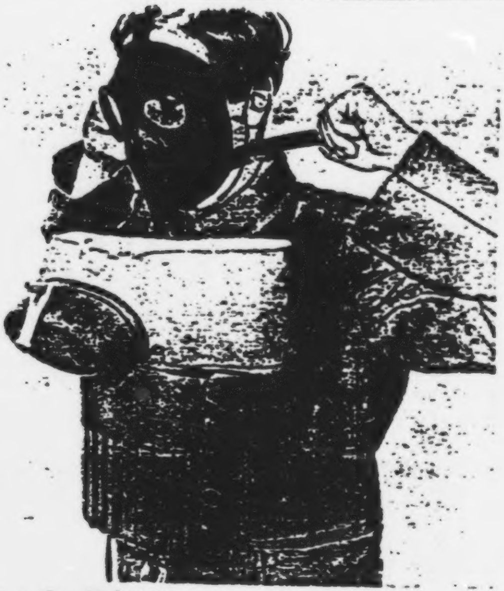


Fig. 4 Oxy-SR® 30 M

breathing bag with pressure relief valve, high pressure control valve with a constant dosage of 1.5 litres/minute and lung demand regulator, corrugated breathing tube with mouthpiece set i.e. breathing-protection mask.

With the cover open, breathing connection fitted, and cylinder valve open, the lung demand valve supplies oxygen over and above the constant dosage to flow into the breathing bag to meet the wearer's requirements, which is particularly important in the first few seconds.

The expired air passes through the breathing tube into the soda lime container, where the carbon dioxide is absorbed. The respirable air then flows into the breathing bag where oxygen from the constant dosage unit is added. On inhalation, the air flows via two non-return valves and the breathing tube to the mouthpiece. The self rescuer Oxy SR® 30 is thus a self-contained breathing apparatus.

With low body work, excess breathing air is discharged into the atmosphere through the pressure relief valve.

When the apparatus is put into operation it functions entirely automatically.

After use, the oxygen cylinder must be re-charged and the soda lime canister refilled.

The Oxy SR® 30 will be delivered in two different types.

- Oxy SR® 30 with mouthpiece-set and gas-protection glasses fitted into cover of casing.
- Oxy SR® 30 with breathing-protection mask. The cover of this apparatus was made higher, so that it can take a small elastic full-mask.

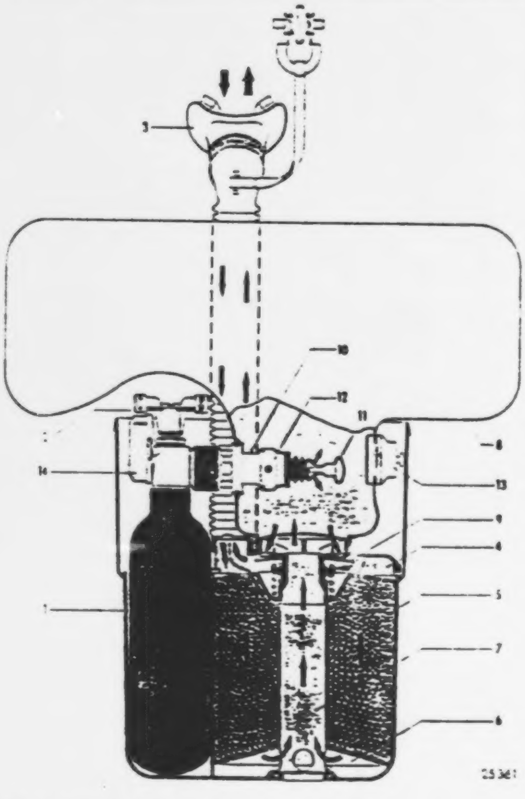


Fig. 5 Circuit diagram of the Oxy SR® 30

1 Oxygen cylinder
2 Lever valve
3 Breathing tube with mouthpiece and nose clip
4 Valve chamber
5 Soda lime
6 Collecting chamber
7 Central pipe
8 Breathing bag
9 Non-return valve
10 Control valve
11 Control lever for lung demand regulator
12 Constant dosage unit
13 Pressure relief valve
14 Valve with pressure gauge

1
Description

1.1
General

The oxygen set BG 174 is a back-worn breathing apparatus which enables the miner or fireman to work in atmospheres deficient in oxygen or containing respiratory poisons. It renders the wearer completely independent of the surrounding atmosphere and enables him to save lives and equipment, even when performing extremely heavy physical work.

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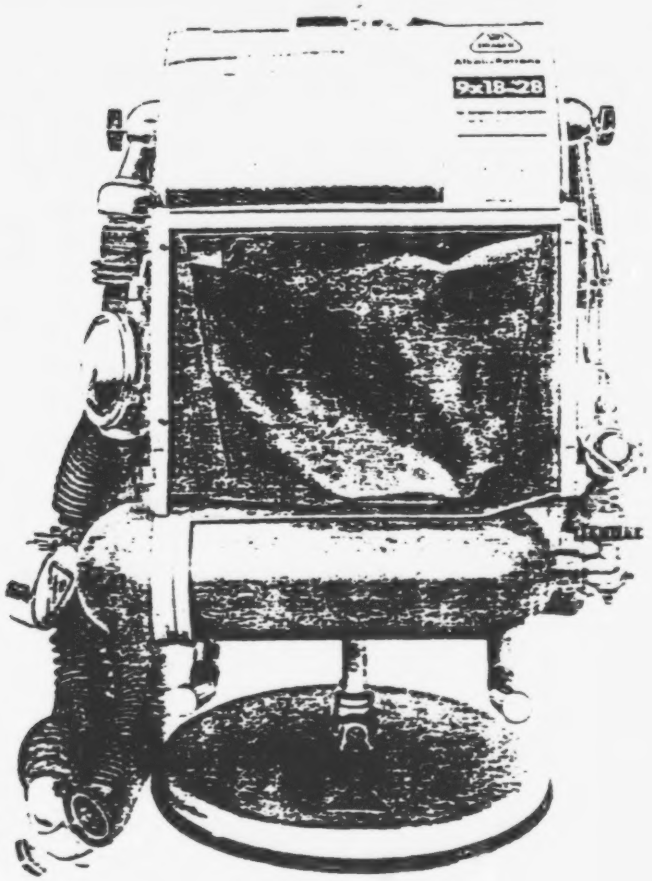

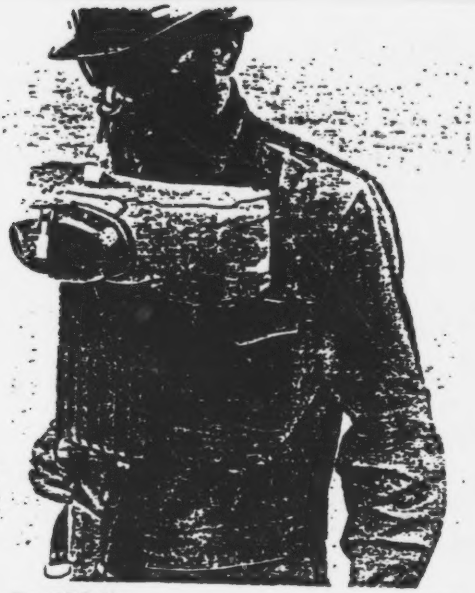

Fig. 3 Oxy-SR® 30

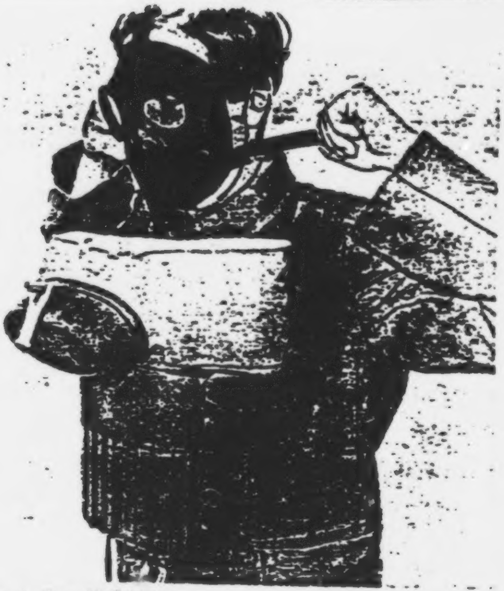

Fig. 4 Oxy-SR® 30 M

breathing bag with pressure relief valve, high pressure control valve with a constant dosage of 1.5 litres/minute and lung demand regulator, corrugated breathing tube with mouthpiece set i.e. breathing-protection mask.

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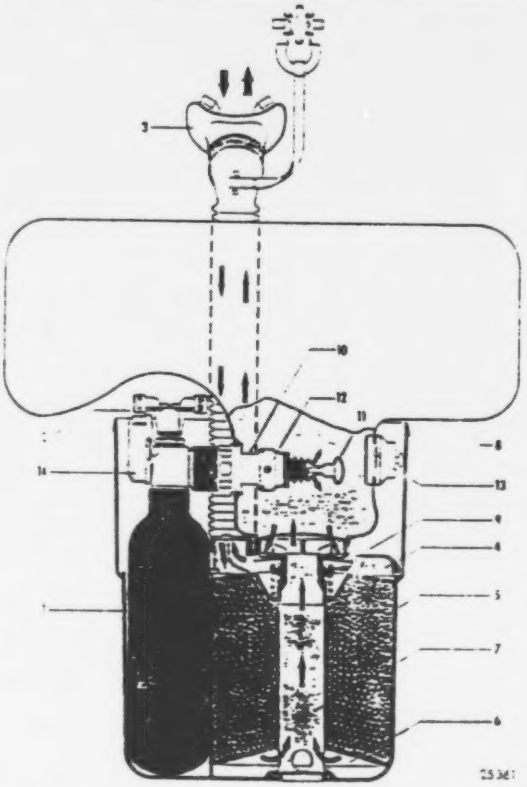
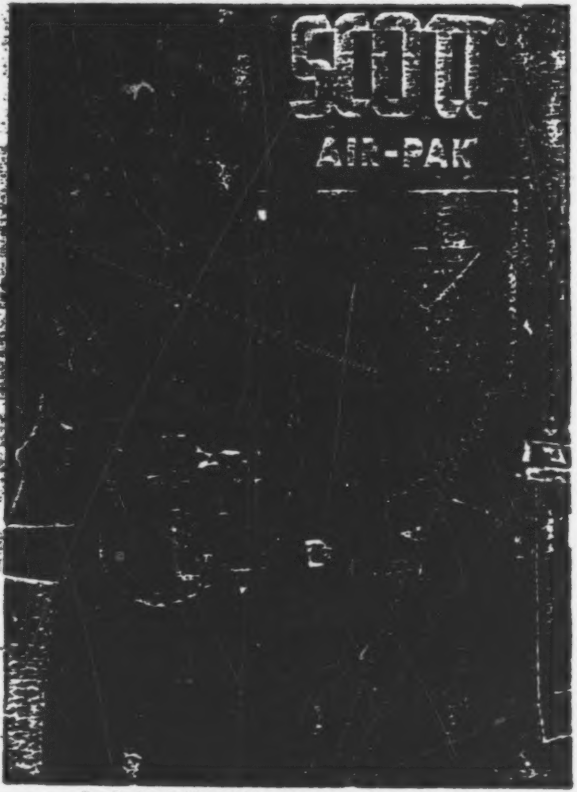


Fig 5 Circuit diagram of the Oxy SR® 30

1	Oxygen cylinder	8	Breathing bag
2	Lever valve	9	Non-return valve
3	Breathing tube with mouthpiece and nose clip	10	Control valve
4	Valve chamber	11	Control lever for lung demand regulator
5	Soda lime	12	Constant dosage unit
6	Collecting chamber	13	Pressure relief valve
7	Central pipe	14	Valve with pressure gauge

CANADIAN MINE RESCUE
SCOTT AIR-PAK®
MODELS IIA AND 2.2
MAINTENANCE AND PARTS MANUAL



SCOTT AIR-PAK®
POUR LE SAUVETAGE DANS LES MINES DU CANADA
MODÈLES IIA ET 2.2
NOTICE D'ENTRETIEN ET DES PIÈCES

®SAFETY SUPPLY CANADA
Mining and Mine Rescue Division
Division de l'exploitation minière et du sauvetage dans les mines
797 Lorne Street South — Sudbury, Ontario P3C 4R5
Telephone (705) 674-5871 Telex: 067-7585

PRINTED IN CANADA

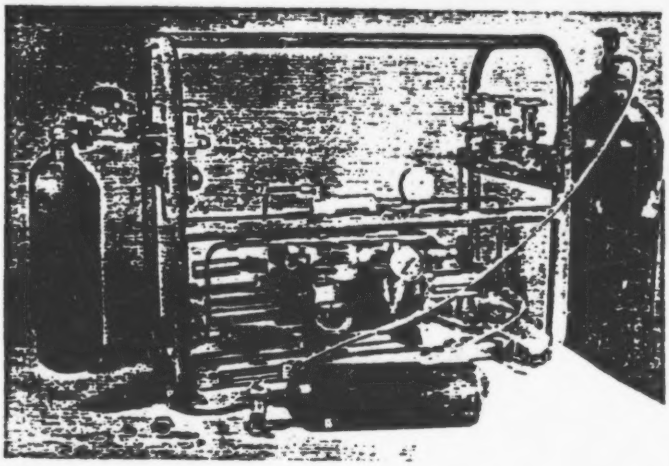
SAFETY SUPPLY CANADA
Mining & Mine Rescue Division NEWS

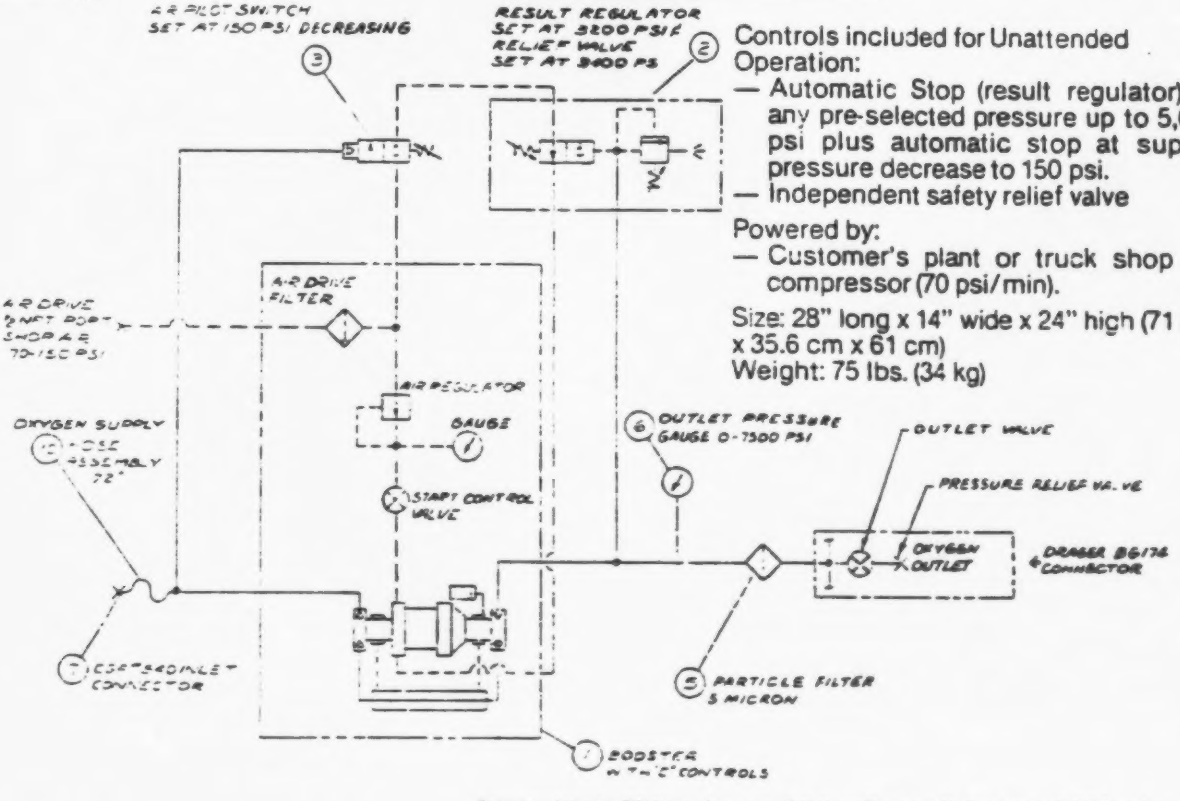
Haskel Air-Driven High Pressure Oxygen Booster Pump for Mine Rescue Breathing Apparatus!

Designed primarily for recharging high pressure cylinders with pure oxygen for use in the Drager Model BG174 and Drager Oxygen SR30 and 45 Mine Rescue Breathing Apparatus.

Two stages of compression permit pump-down of a supply cylinder to as low as 150 psi while boosting to 5,000 psi output.

The Model 51563-2 is a complete system including a supply cylinder connection hose, all necessary interconnecting tubing, fittings, booster, controls, gauges and Drager handwheel connector with bleed off valve. The system is portable and comes installed in a tubular frame suitable for floor or bench mounting.




AIR PILOT SWITCH
SET AT 150 PSI DECREASING
③
RESULT REGULATOR
SET AT 3200 PSIF
RELIEF VALVE
SET AT 3400 PS
②
AIR DRIVE
FILTER
AIR DRIVE
1/2 NPT PORT
SHOP AIR
70-150 PSI
AIR REGULATOR
GAUGE
START CONTROL
VALVE
OXYGEN SUPPLY
HOSE
ASSEMBLY
72"
CGA 540 INLET
CONNECTOR
⑥ OUTLET PRESSURE
GAUGE 0-7500 PSI
OUTLET VALVE
PRESSURE RELIEF VALVE
OXYGEN
OUTLET
DRAGER BG174
CONNECTOR
⑤ PARTICLE FILTER
5 MICRON
① BOOSTER
WITH "C" CONTROLS

Controls included for Unattended Operation:
- Automatic Stop (result regulator) at any pre-selected pressure up to 5,000 psi plus automatic stop at supply pressure decrease to 150 psi.
- Independent safety relief valve

Powered by:
- Customer's plant or truck shop air compressor (70 psi/min).

Size: 28" long x 14" wide x 24" high (71 cm x 35.6 cm x 61 cm)
Weight: 75 lbs. (34 kg)

Approximate fill time for one 2.5 litre Drager Cylinder to 3.000 psi

Supply Cylinder Pressure	2,000 psi	1000 psi	500 psi	200 psi
*Time to fill to 3000 psi	1 min.	3 mins.	8 mins.	20 mins.

*Based on drive power of approximately 120 psi at 20 scfm. Lower pressure or volume will increase recharge time proportionally.

Rz 25 from Dräger
The Portable Universal Tester for Breathing Apparatus

So that oxygen breathing apparatus, compressed-air respirators and respiratory protection masks are always ready for use

Rz 25 reliably and precisely checks the functions of breathing apparatus with specific test programmes for

- Oxygen breathing apparatus and oxygen self rescuers
- Compressed-air breathing apparatus and light compressed-air diving apparatus
- Respiratory protection masks

Rz 25 is portable and can be used anywhere:

- in respiratory protection centres
- in respiratory protection workshops
- directly on site, even underground

Rz 25 is recommended by the apparatus test office of the German Mines Rescue

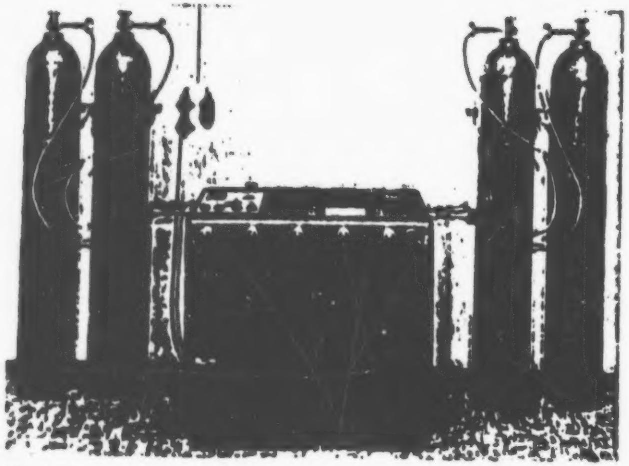


Fig. 1 Transfer unit with High Pressure Oxygen Transfer Pump Model U 300 DS

1. Description

1.1. Designation

1.1.1.	**Name:**	High Pressure Oxygen Transfer Pump
1.1.2.	**Model designation:**	U 300 DS
1.1.3.	**Order number:**	U 3500
1.1.4.	**Manufacturer:**	DRAGERWERK · AG · LUBECK

1.2. Technical data

1.2.1.	**Dimensions:**	Overall length:	940 mm
		Overall height:	920 mm
		Overall width:	550 mm
		Installed width:	750 mm
		See also fig. 2	
1.2.2	**Weight:**	app. 220 kg	

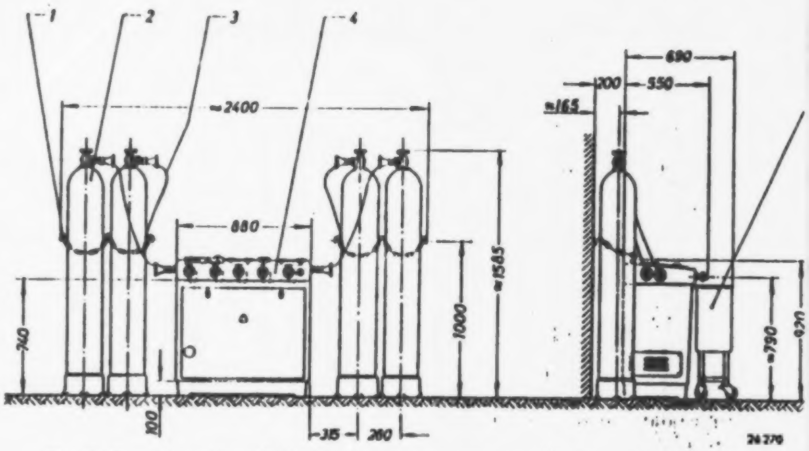


Fig. 2 Transfer unit with High-Pressure Oxygen Transfer Pump Model U 300 DS

1 Cylinder mounting
2 Oxygen cylinder
3 High-pressure tube
4 High-pressure oxygen transfer pump Model U 300 DS
5 Cooling water container

1.2.3. **Operating data:**

Motor:	Standard three-phase motor 220/380 V, 50 cps, connected to Y 380 V for direct switching in Rated power 1.5 kW Rated speed 3000 rpm; Other voltages and frequencies possible as special construction (on inquiry)
Gears:	Worm gearing i = 15.5 : 1 (with 60 cps motor, i = 20.5 : 1) Driving speed app. 180 rpm For types of oil and quantity of oil see 1.4.14
Pump:	Single-stage, 2-cylinder, piston diameter 14 mm, automatic lubrication

Mining &
Mine Rescue
Division

NEWS

Mine Warning System

Mercaptan MWD-100

THIS END UP
ZIP
MERCAPTAN
STENCH
CARTRIDGE
(MINE WARNING DEVICE)
MWD-100

This low cost and easy-to-install device provides a positive method of injecting a measured amount of ethyl mercaptan purified into existing operational compressed air systems. The MWD-100 Stench Cartridge has an operating temperature range between 35° F (2° C) and 130° F (55° C). Within this temperature range the cartridge will empty itself completely into a 150 psi (1,034 kpa) air system.

Contains 100 grams of ethyl mercaptan purified and sufficient nonflammable fluorinated hydrocarbon propellant to operate within the above temperature range. Where extreme operating temperatures are encountered, a protective enclosure should be installed to keep the mine warning device within the operating temperature range. Special versions of the MWD-100 Stench Cartridge are available where the operating temperature range is above or below 35° F (2° C) to 130° F (55° C) operating range of the standard cartridge. Our technical staff is available to help solve special problems. This system is flexible and can satisfy the most exacting requirements. The MWD-101 Kit is available to simplify the installation of the Stench Cartridge.

Ordering Information:

Catalogue Number	Product Code	Item
MWD-100	145Y001	Mercaptan Stench Cartridge (100 grams)
MWD-101	145Y002	Installation Kit

Mining & Mine Rescue Division
SAFETY SUPPLY CANADA

797 [illegible] Street South • Postal Code P3C 4R5
Sudbury, Ontario
Telex 067 7585 Telephone (705) 674-5871

516-SC-482

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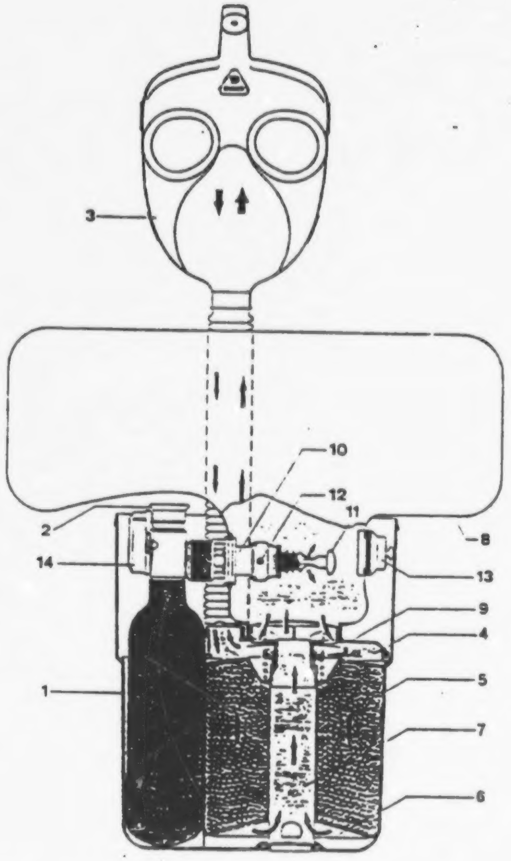
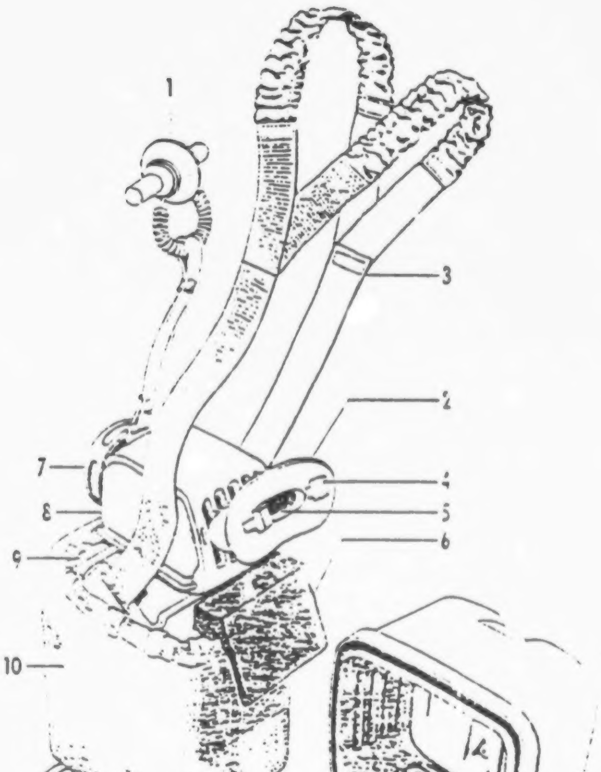


1 Oxygen cylinder
2 Button type valve
3 Breathing tube with mask
4 Valve chamber
5 Soda lime
6 Collecting chamber
7 Central pipe
8 Breathing bag
9 Non-return valve
10 Control valve
11 Control lever for lung demand valve
12 Constant dosage unit
13 Pressure relief valve
14 Valve with pressure gauge

Fig. 2 Circuit diagram of the Oxy-SR® 45 M



1 Nose clip
2 Mouthpiece
3 Head harness
4 Bits
5 Air passage
6 Chin support
7 Exhalation valve
8 Mouthpiece casing
9 Filter
10 Coarse dust filter
11 Container cover
12 Container canister

FILTER SELF RESCUER TYPE SR 910

APPENDIX VII
MINE RESCUE EQUIPMENT

SECTION 7.3
EXAMPLES OF MAINTENANCE RECORDS

Ontario
Ministry of
Labour

Drager BG174 Apparatus Tests - Monthly

App. No.	Sheet 5A Repairs	Mine Rescue Station	Year	Sheet No. 5

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Date Tested												
Cyl. No. and Pressure (PSI.)												
Inhal. and Exhal. Valves												
Preflushing Action												
Constant Flow in L/Min.												
Demand Valve (-MM-WG.)												
By-pass Valve												
Relief Valve (+MM-WG.)												
High Pressure Test												
Warning Signal												
Low Pressure Test												
Regenerator Cleaned												
Reducing Valve Shut-off Pressure												

Ontario
Ministry of
Labour

OXY-SR Self Rescuer Station Tests - Quarterly

Quarter
Mine Rescue Station
Year
Sheet No.
7

Apparatus No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Date of Test																		
General Condition																		
Bottle Pressure																		
Positive Pressure Test																		
Relief Valve																		
Constant Flow Lit/Min.																		
Demand Valve																		
Negative Pressure Test																		
Soda - Lime Full or Replaced																		

Ontario
Ministry of
Labour

Demand Apparatus Tests

App. No.

Sheet 6A Over
Repairs and Replacements

Mine Rescue Station

Year

Sheet No. 6

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Date of Test												
General Condition of Equipment												
Bottle No. and Pressure												
Comparable Gauge Check												
Regulator and Diaphragm												
By-Pass Valve												
Litre Flow and Water Gauge												
Facepiece and Breathing Type												
Charging Assembly												
Harness												

Remarks:

Tested by

[illegible]

Date: ____________

MINE RESCUE - DRAGER BG-174 STATION TESTS

Date of Last Test: ____________

MINE SITE: MANITOBA

APPARATUS NUMBER	POSITIVE PRESSURE LEAK TEST	PRESSURE RELIEF VALVE 15mm to 40mm	DOSAGE 1.4 to 1.7 LITRE PER MINUTE	LUNG DEMAND VALVE -15mm to -40mm	NEGATIVE PRESSURE LEAK TEST	OXYGEN BOTTLE PRESSURE IN P.S.I.	REMARKS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Comments: ____________

IOTE: ALL TESTS ARE TO BE DONE AT LEAST ONCE EVERY 3 MONTHS.

PLEASE KEEP STATION TEST RECORDS ON FILE FOR A 12 MONTH PERIOD.

Signature: ____________

Gouvernement du Québec
Ministère de l'Énergie
et des Ressources

DIVISION DES POSTES DE SAUVETAGE DANS LES MINES

RAPPORT D'ÉQUIPEMENT

À être rempli à toutes les deux semaines aux postes principaux et à chaque visite aux postes secondaires.

POSTE DE SAUVETAGE AGNICO-EAGLE DATE LE 25 NOV 1982

APPAREIL DRAGER - BG - 174

NUMÉRO DE L'APPAREIL	PRÉ-RINÇAGE	PULMO COM AUTOMATIQUE	VALVE DE DÉRIVATION	DOSAGE	PRESSION DU CYLINDRE	PRESSION POSITIVE	SOUPAPE DE SURPRESSION	SIGNAL D'ALARME	PRESSION NÉGATIVE	ÉTAT DE L'APPAREIL
25	Bon	34	Bon	1.55	1400	Bon	28	Bon	Bon	Bon
26	"	40	"	1.51	1600	"	32	"	"	"
27	"	32	"	1.58	1600	"	32	"	"	"
28	"	34	"	1.61	1400	"	34	"	"	"
29	"	38	"	1.52	1500	"	30	"	"	"
30	"	32	"	1.51	1600	"	32	"	"	"

OXY - SR - 45

NUMÉRO DE L'APPAREIL	RÉGÉNÉRATEUR ABSORBANT-CO²	PRESSION DU CYLINDRE	ÉTAT DE L'APPAREIL
25-N	Bon	Bon	Bon
26-N	"	"	"
27-N	"	"	-
28-N	à Noranda		
29-N	Bon	Bon	Bon
30-N	à Noranda		

APPAREIL DÉFECTUEUX

N°	NOM DE L'APPAREIL	DEFECTUOSITES

	POMPE A OXYGÈNE	COMPRESSEUR À AIR
USAGE		
ÉTAT		
DEFECTUOSITE		

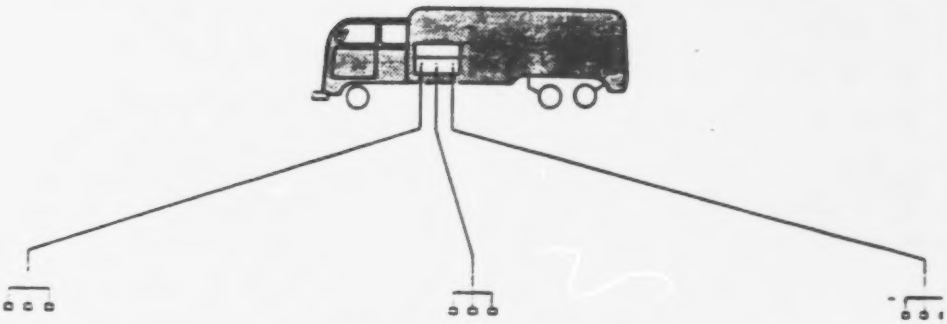
CAMION DU POSTE DE SAUVETAGE

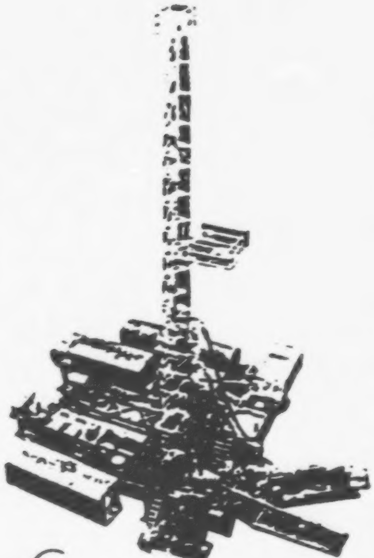
N° DE L'ENREGISTREMENT

N° DU VÉHICULE ENR. AU GOUV.

SECTION 7.7

EQUIPMENT USED FOR UNDERGROUND EMERGENCIES





Mine Emergency Operations

Much technology has been focused on preventing disaster-type accidents in underground mines. But if an explosion, fire, or cave-in does occur and miners are trapped underground, rescue and recovery operations must be started immediately.

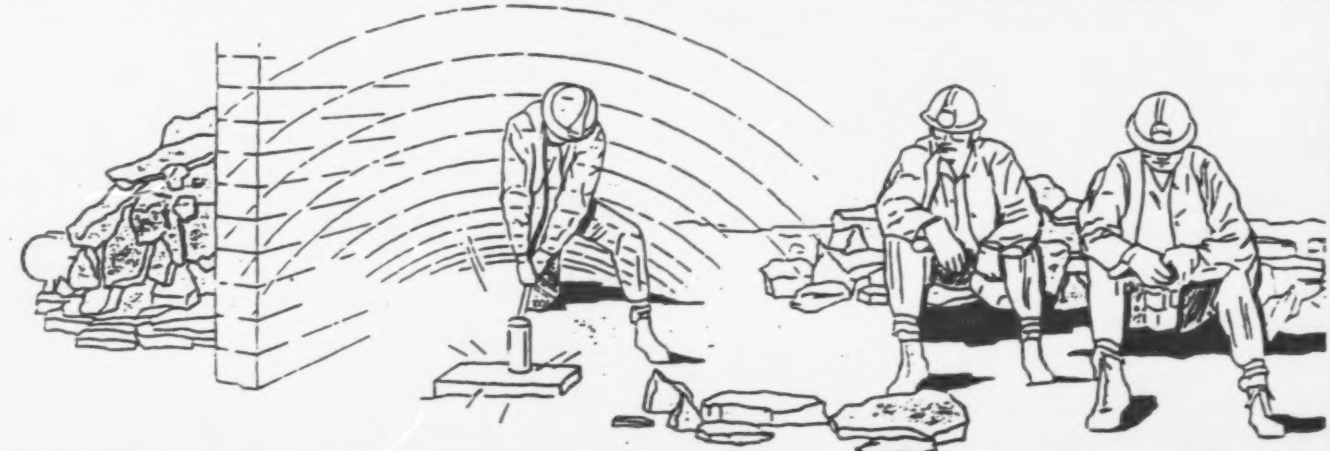
When a mine rescue team cannot reach the entrapped men by conventional, "through-the-mine" rescue methods, MESA's "from-the-surface" Mine Emergency Operations (MEO) Group is called upon.

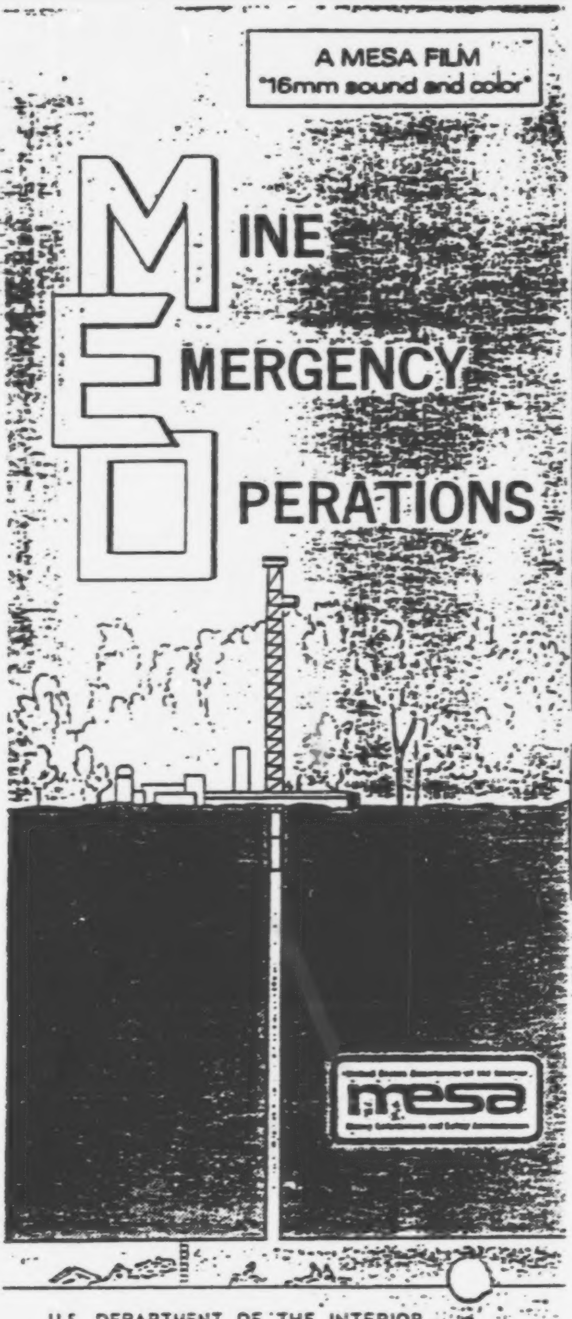
Now a 17-minute, 16 mm., color motion picture is available showing the MEO search-and-rescue system in action. The film describes the manner in which surface operations are conducted, and emphasizes the steps trapped miners must take to be rescued.

A simulated disaster is staged at a mine location. Men are trapped underground and the MEO system is put into operation. Using live-action photography and animation, the film demonstrates MEO techniques and procedures, and explains the rescue group's three basic functions: locating miners trapped underground, establishing life support systems and communications with them, and rescuing them through a shaft drilled from the surface.

Special seismic location equipment is used to locate and communicate with men underground. Geophones —sensitive instruments used in earthquake research— are deployed on the surface to pick up vibrations set off when the mine floor or a roof bolt is struck 10 times by a trapped miner using a heavy object. Data from these geophones is processed in a portable computer to determine the location of the signal source—the men trapped underground.

When their location has been determined, probe and rescue drilling operations are then made. First, a hole is drilled to provide voice-communications, oxygen, food and first aid; then a second, larger hole is drilled through which the men can be lifted to the surface.

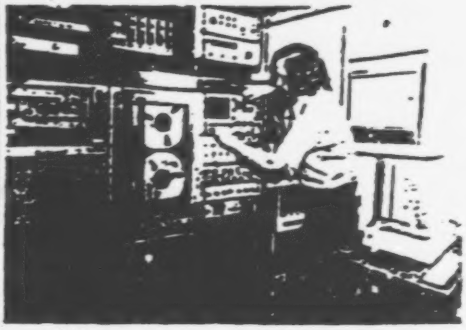




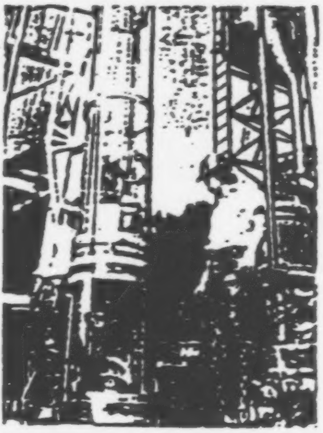
MINE EMERGENCY OPERATIONS

U.S. DEPARTMENT OF THE INTERIOR

GEOPHONE AMPLIFIER



COMMUNICATIONS OPERATOR & EQUIPMENT



ESCAPE CAPSULE

Prospective borrowers, when requesting this film should state that they have a 16-millimeter sound projector and an experienced operator.

Requests for prints of the "Mine Emergency Operations (MEO)" film (No. 858) should be addressed to:

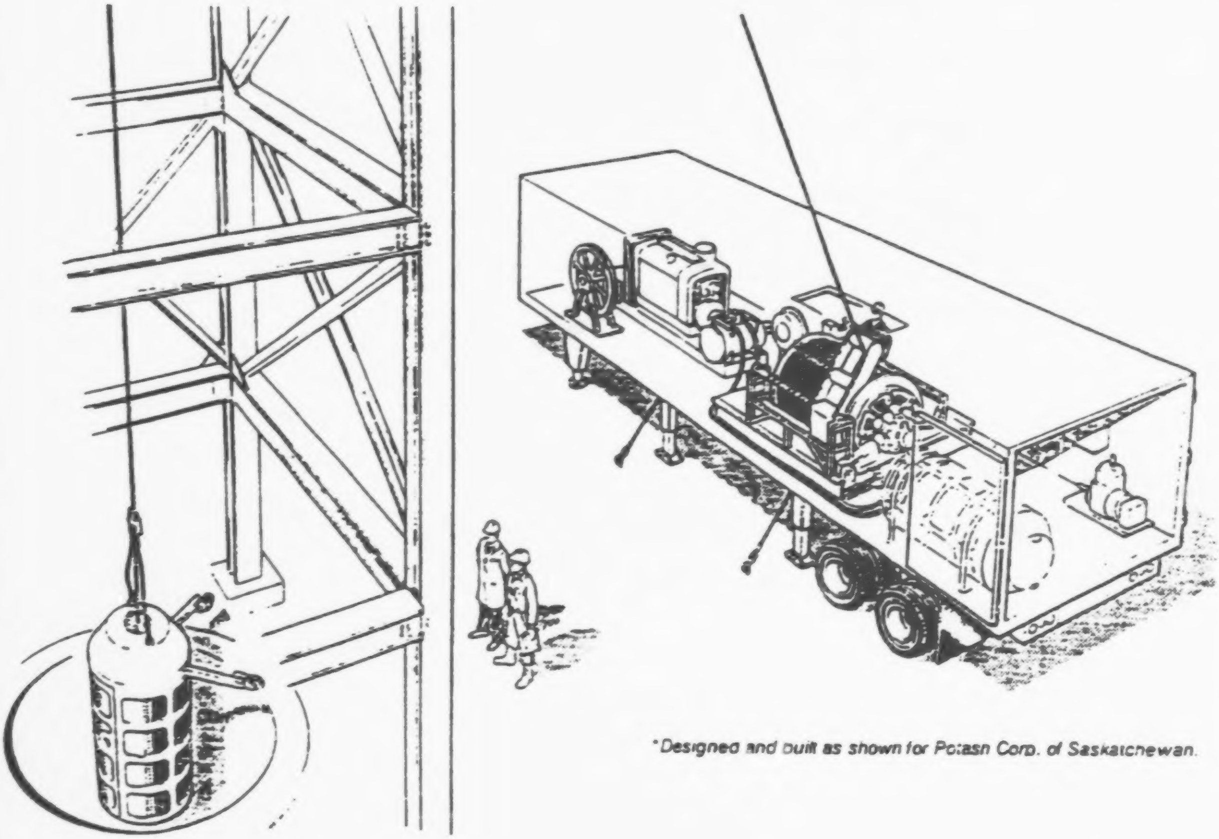
Motion Picture
Distribution Center
Mining Enforcement and
Safety Administration
4800 Forbes Avenue
Pittsburgh, Pa. 15213

MESA pays outgoing postage on films, but borrowers must pay for return mailing, and any damage to prints other than normal wear.

March 3 1849

PMRH-TRAILER MOUNTED*

For use with existing structures.
For medium to deep shafts.



*Designed and built as shown for Potash Corp. of Saskatchewan.

- Diesel/hydraulic powered with hydrostatic transmission.
- Shaft depths to 6,000 feet (special designs available for deeper shafts).
- Rope capacity and line pull to suit application.
- 38" and 44" dia. cages standard — other sizes available.
- Cage guides, rope or wall type, optional.
- Complete unit available with auxiliary electric generator, air conditioning and heating systems and other accessories.
- Basic hoist module and head sheave available for customer trailer mounting.
- Hydraulic jacks support hoist load independent of trailer frame and suspension.
- Optional booms and auxiliary structures available for complete system installations.
- Trailer storage for cage.
- Designed to meet MSHA guidelines.

TIMBERLAND EQUIPMENT LIMITED
P.O. Box 490
Woodstock, Ontario, Canada N4S 7Z2
Telephone (519) 537-6262

**Our people care . . .
our equipment is the proof**

APPENDIX VII
MINE RESCUE
EQUIPMENT

SECTION 7.8
REFUGE STATION

COMINCO

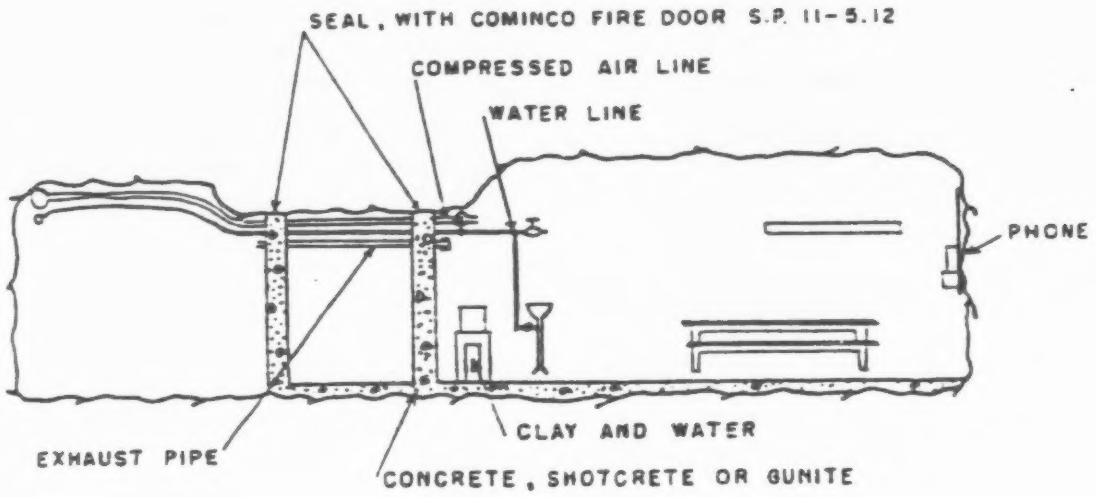
SULLIVAN MINE

KIMBERLEY. B C.

STANDARD PRACTICES

REFUGE STATION

TITLE


SEAL, WITH COMINCO FIRE DOOR S.P. 11-5.12
COMPRESSED AIR LINE
WATER LINE
PHONE
EXHAUST PIPE
CLAY AND WATER
CONCRETE, SHOTCRETE OR GUNITE

DETAILS

Size: 24 cu. yds. x maximum number of men in the area at any time.

Construction:

a) Bar walls and back and clean floor to solid rock.
b) Check for cracks or holes which will have to be sealed.
c) 6" concrete or 12" shotcrete (gunite) seal to be installed in all openings and to be keyed into the rock.
d) Install a concrete or shotcrete floor.
e) Cominco fire door to be installed in all doorways after all wood has been removed. SP 11-5.12
f) Inlets for air, water and power must be sealed after installation.
g) Exhaust pipe to be threaded and fitted with a cap.
h) Floor drains to have a trap.
i) Check for air tightness.

Equipment & Furnishings:

Minimum

Compressed air and drinking water (fountain & hose outlet.
Automatic telephone with emergency numbers posted and index.
Adequate lighting (fluorescent preferred).
Heater and warming oven.
Fully equipped stretcher and first aid box.
Fire extinguisher.
Sealing clay and water.
Bulletin board with emergency instructions.
Dining table, benches and clothes rack.
Signs L6, M5, L3 and L1.
Sink with hot and cold water. (20 gal. hot water tank)

Optional

Life support system complete with chemical toilet, emergency lighting, water, food, blankets, paper, pencils, etc. Compressed Air bottles

Note

Cominco Fire Door SP 11-5.12, height and width may be modified when necessary.

J.W. Reynolds
SUPERVISOR TECHNICAL DEVELOPMENT

16 April 1975
DATE

REMARKS

MINE SUPERINTENDENT

1[illegible] April, 1975
DATE

COMINCO LTD.

SULLIVAN MINE KIMBERLEY, B.C.

STANDARD PRACTICES
OPERATING
REFUGE STATIONS

12-8.2.1

---

1. Refuge stations are set up and maintained to meet operating needs for coping with emergencies. The number, location and size of refuge stations will be governed by operating requirements. Refuge stations are gathering points where men will go as the first stage of escape from the mine. They form a key part of rescue planning organization.

2. All refuge stations must have the minimum equipment listed on S.P. 12-8.2.

   Optional equipment to be approved by the Superintendent, Sullivan Mine.

3. Rating of Refuge Stations

   Each refuge station will be numbered and rated and the rating will be posted where the users can see the rating. The rating will show:

   a. Man-hours for that refuge station without compressed air.

   The ratings will be kept current by the Safety Department who will maintain maps and current ratings for all refuge stations as priority information for use in emergencies.

4. Construction of Refuge Stations

   Refuge stations will be constructed according to Standard Practice 12-8.2, as revised from time to time.

5. Testing

   When built refuge stations will be tested for air tightness by designated ventilation technicians. Thereafter a monthly inspection will be made by a first line supervisor. Date of inspection will be posted in each refuge station and recorded in the Safety Office.

J. W. Reynolds
Superintendent Development

16 April 1975
Date

Superintendent Sullivan Mine

16 April, 1975
Date

SECTION 7.9

TRAPPED MINER TRANSMISSION

A U.S.B.M. DEVELOPMENT

THROUGH THE EARTH TRANSMISSION

(T.M.T. TRAPPED MINER TRANSMISSION)

There is being tested a "TMT" device in which signals can be passsed between surface and underground. The following text gives some information on this device. Further information should be sought through Mr. Harry Dobroski of the U.S.B.M., Bruceton Research Centre. The device has been performance tested at about 100 U.S. Mines and is now undergoing reliability tests.

SECTION 7.9

TRAPPED MINER TRANSMISSION
A U.S.B.M. DEVELOPMENT

THROUGH THE EARTH TRANSMISSION

(T.M.T. TRAPPED MINER TRANSMISSION)

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TEXT FOR:

TMT OPERATION AND APPLICATION

FEB 18 REC'D

In an emergency, the new transceiver is snapped onto a caplamp battery for power. (Normally the 1 1/2-pound transceiver is either carried by the miner or is strategically located in the mine.) Its antenna wire, coiled inside the transceiver container, is removed and deployed in a roughly square configuration around a coal pillar or on the mine floor. The antenna consists of 300 feet of lightweight wire, which provides a large magnetic moment while remaining intrinsically safe.

When energized, the transceiver begins transmitting tone pulses through the earth. The tone during pulses is in the voice frequency band. The duty cycle has an On-time of 1/10 second and an Off-time of 9/10 second. This combination of frequency and duty cycle makes the signal more readily detectable on the surface.

In some situations, the possible location of trapped miners could encompass several square miles. For this reason a helicopter search receiver was developed to allow a rapid scan over a large region. This scan roughly locates the signal source. A surface crew is then dispatched into that area to more precisely determine the miners' lateral location. Usually this can be determined within a few tens of feet, depending mostly on overburden depth and earth conductivity.

Once the location is fixed, a large loop antenna and power amplifier are deployed on the surface, and a one-way voice conversation can be transmitted to the trapped miners' transceiver.

Surface personnel ask the miners "yes/no" type questions concerning their condition and that of the mine. The miners respond by keying the transceiver, one pulse for yes, two pulses for no. Other questions can be answered with an appropriate number of pulses. The information obtained can be vital in planning and executing rescue.

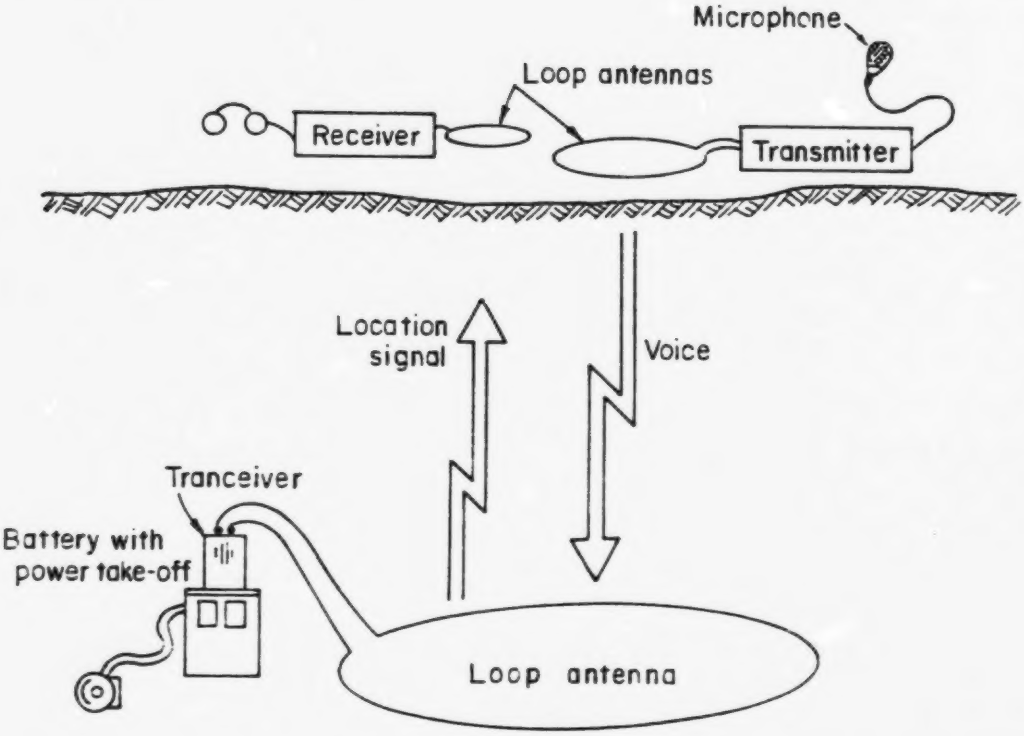
BENEFITS OF TMT EVALUATION PROGRAM AND EM TECHNOLOGY

- Determines TMT resistance to performance deterioration during exposure to mine environments.
- Determines ability of TMT to function under emergency conditions after long term exposure to mine environments.
- Determines service life of TMT for consideration of repair/replace cycle.
- Determines deficiencies in TMT design relative to mine exposure.
- Utilizes a technology with proven performance in coal mines.
- TMT units are ready for immediate deployment.

BIMONTHLY PERFORMANCE TESTS

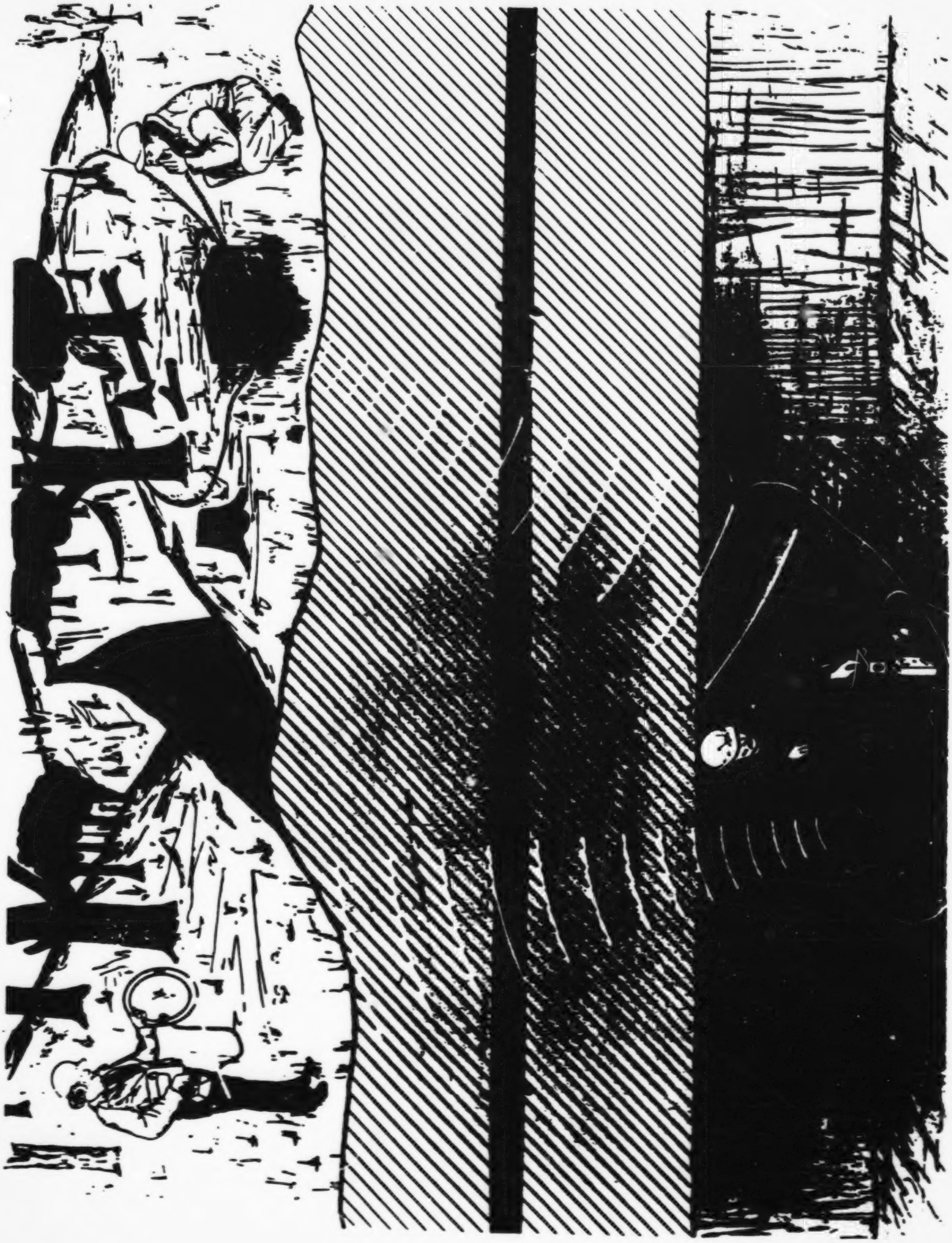
The following tests will be performed on the 10 TMT units deployed at this mine every two months.

- Physical Inspection
- Antenna Continuity
- Carrier Frequency
- Modulation Frequency
- Antenna Output
- Receiver Operation (where applicable)

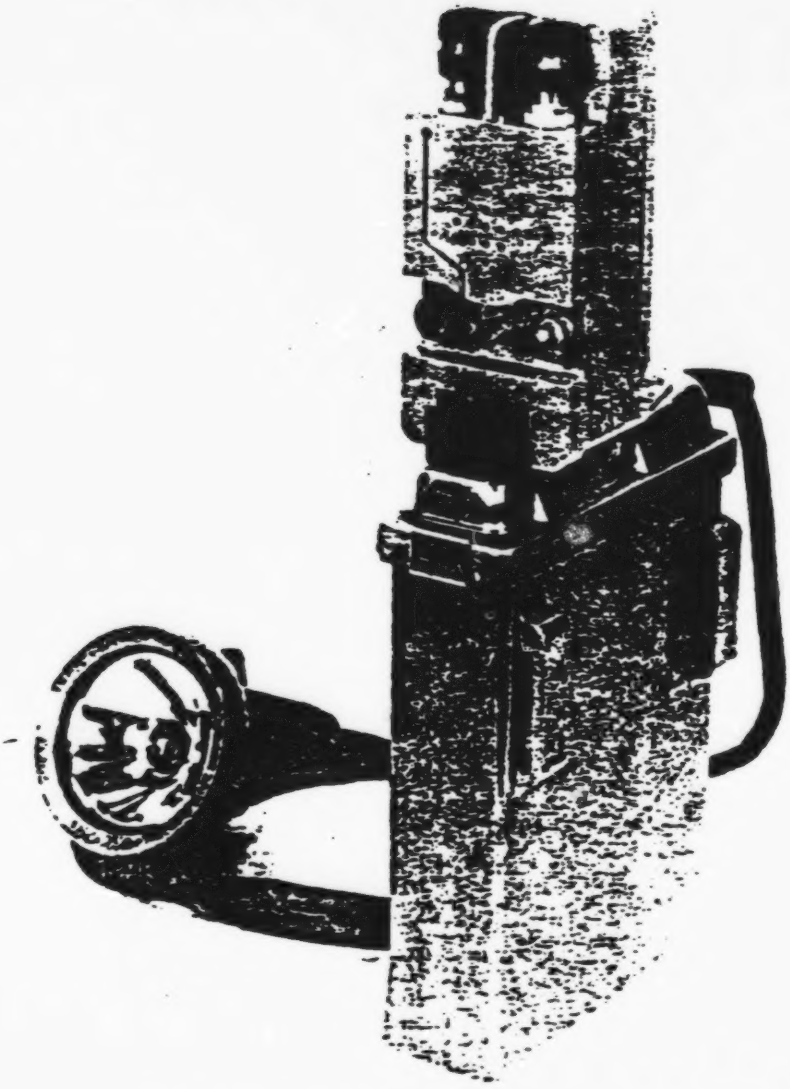

Microphone
Loop antennas
Receiver
Transmitter
Location signal
Voice
Tranceiver
Battery with power take-off
Loop antenna

THROUGH THE EARTH TRANSMISSION SYSTEM

PGH-78
67



THE TMT



Transceiver mounted on caplamp battery.

POOR

QUALITY

ORIGINAL